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Cover photograph: King Cobra *Ophiophagus hannah* by Shekar Dattatri

Editorial

Conservation of Snakes in India

In 1934, Malcolm Smith writes in his Introduction to Volume II of FAUNA OF BRITISH INDIA (the lizard volume): "The annual slaughter of reptiles for trade purposes is now enormous, and unless measures are taken to control it, certain species are in great danger of being exterminated." Smith went on to quote a figure of 5,250,000 reptile skins exported from India in 1932 and 1933. Virtually nothing was done for the next forty years to stem the trade in reptile skins.

Skin Trade: In the late 1960s, snake skin exports peaked at an estimated 10 million skins per year. This figure was arrived at by putting a value of Rs. 10/- on each of the Rs. 107 millions worth of skins exported in 1967-1968. In 1978, in COMMON INDIAN SNAKES, I wrote, "The snake skin industry means employment for the tribals, but as there is no control on numbers and season, and since the middlemen get the major profit at this end, it is both ecologically and economically unsound." It wasn't until 1975-1976 that most snakes received some paper protection. The Wildlife Act listed only the python in those days and it was the Export Policy for Wildlife Products, that finally began what was a long rocky road to protection with muscle. Eventually, all snakes found some form of protection under the Wildlife Act. It then took a lot of effort by State and Central Wildlife Staff, Customs and Police officers to finally bring the snake skin trade down to a cottage industry level trickle. An important factor was the comparatively low profits from snake skins. Smugglers are versatile and will shift focus from high-risk bulky items like snake skins, which don't yield top returns, to other big earners like dope and tiger parts.

Snake Ecology: No one knows what the ecological implications of such a slaughter have been. But the removal of perhaps one billion rodent eating snakes and lizards in the forty years following Smith's amazingly "hip" conservation message, cannot have helped Indian agriculture very much. In fact, it might be wildly surmised that we are only now recovering from the ecological disturbance of those decades, as snake populations reach former levels of abundance. (Ah, for a study of rat and snake ecology in India's grain fields!).

Snakes in Cities: Well, the reptile skin trade is fairly well under control (the few seizures of snake skins you read about in the papers these days means that there is still a small scale underground trade), but people still kill snakes just because they're snakes. In the last two decades, the number of snake rescue services in cities in India has proliferated, following the example of our Madras Snake Park service begun in 1970. So in Kolkata, Mumbai, Chennai, Bangalore, Baroda and Rajkot there are well known "snake people" who are on call to catch that snake which blundered into your house looking for a juicy rat. Yes, the English media, nature clubs for well-to-do city kids and the general concept of wildlife being "with it" has popularized snakes amongst Indian urbanites like never before. I'm not complaining, it's just that there is no effort being made to take the same awareness into the countryside, where most of the snakes (and Indians!) live. Where are those grassroots programmes for conservation in local languages?

Snakes in Villages: People in villages are scared of snakes, because they have a personal experience of someone known to them dying from snakebite. So what if they eat rats, "the only good snake is a dead snake." We are hardly beyond the primitive state of 100 years ago, before there was an effective cure for snakebite. Antivenom serum is now available in most major hospitals (in towns and cities), but is just as often not available in

the Primary Health Centres and Rural Clinics that serve rural people. No wonder there can be little headway with the message "snakes are friends of the farmer." If it wasn't for religious sentiment (mainly concerning cobras), snakes would be hunted out of existence as have most other life threatening wild animals. So we see that conservation of snakes in India is very much linked to awareness: knowing the few dangerous species and the effectiveness of antivenom. But it won't work unless health authorities can guarantee adequate supplies of antivenom serum in rural dispensaries. And it has recently come to light that antivenom serum made using venom of snakes from one region of the country may not be effective against the bite of the same species in another region. No work has yet been done on this problem in India, but we recently found out that Indian made antivenom serum is quite useless against Sri Lankan Russell's viper bite and the king cobra antivenom made in Thailand will not neutralize Indian king cobra venom. All this may seem a bit esoteric in a discussion about conservation of snakes, but it has always been a bit awkward to defend venomous snakes, especially if you can't at least guarantee a cure for their bites!

Habitat loss and the Losers: Big, conspicuous snakes like the python and king cobra are often the first casualties of forest loss. They need the space, hiding places and prey base. But we are losing other smaller forest snakes at an undocumented but predictably rapid rate as their habitat is altered or disappears. Clearing forests raises the ground temperatures and dries out the soil, which spells death for most of the burrowing species like the shieldtail snakes. Many snakes of the Western Ghats again like the shieldtails, pit vipers and coral snake, plus a number of others like the pit vipers and trinket snakes of the Northeast, Andaman cobra and Cantor's pit viper of the Andamans and Nicobars are endemics and have evolved to fit neatly into the conditions prevailing in the once pristine forests. It is our great loss that many of these are losing ground without anyone even noticing. Sri Lanka has similar problems and has lost over 80% of the country's wet tropical forests and all the amazing biodiversity therein. Yet, in the tiny fragments remaining, field biologists with the Sri Lankan Wildlife Heritage Trust have discovered as many as 200 new species of frogs just in the last few years! This is an amazing revelation and points to the obvious likelihood that much biodiversity in our own dwindling rain forests (including new snakes) remains to be discovered.

The Survivors: Humans have an uncanny knack of messing up natural systems, sometimes resulting in little twists of irony. Here's one of them: by creating rice fields from forest land we make ideal conditions for rats with plenty of food, water and excellent housing in field bunds. At least three species of snakes, two of them venomous, are fine with this arrangement and quickly adapt to the new season of plenty. Rat snakes, cobras and in some areas kraits, all benefit from our farming methods and the numbers of these snakes are invariably much higher in agricultural areas than in their original "natural" habitat. A few other "minor players" like the rodent eating sand boas, plus the frog lovers such as the striped keelback and checkered keelback, must love us too as we provide them with unnatural concentrations of prey items. An unknown factor is, of course, the increasing chemical fertilizers, pesticides and herbicides. Will snakes suffer the way India's vultures have, once toxic levels reach intolerable concentrations?

No discussion of Indian conservation would be complete without mentioning the only 'sustainable use of wild animals' project in the country. The Irula Snake Catchers Cooperative Society, set up in 1978, has caught well over 75,000 snakes and produces most of the venom used for making antivenom serum. The happy note is that the snakes are released after four extractions, unlike other venom production units in the world, which

milk the snakes till they die (very prematurely). This is a model project wherein a tribe of expert snake catchers continues its traditional occupation, but not at the expense of the natural resource.

To sum up, India has done a pretty good job in clearing up its snake skin trade act, urbanites are starting to love snakes, but country people are still scared and negative about them. Teaching people to identify the dangerous ones and how to avoid and discourage them is vital, as is the publicity and distribution of the right antivenom serum.

Forest loss continues to be a very frightening comment on how we misuse our precious resources, which is resulting in the extinction of many taxa, including snakes, with no one to count the tragic losses. At the same time, there are a few hardy snakes which adapt to our monoculture mania. In a few decades, these may be the only ones left!

ROMULUS WHITAKER

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PRELIMINARY OBSERVATIONS ON DISPLAYS AND POSTURES IN THE ORIENTAL MAGPIE ROBIN *COPSYCHUS SAULARIS*[1]

ANIL KUMAR AND DINESH BHATT[2]

(*With one plate and two text-figures*)

Key words: Visual displays, communication, *Copsychus saularis*, flight display, tail posture, courtship display, threat posture

Animals convey information to members of their own and other species through a number of channels. Changes in posture and colours are their means of visual communication. In the present study, efforts have been made to characterize types of visual signals and their importance in the social life of a song bird, the Oriental magpie robin *Copsychus saularis*. Observations revealed that this bird uses a number of visual signals for communication. Display flights and tail postures are used by the male to attract females. Males perform various courtship ceremonies, stretching the head forward and downward in front of females, spreading their tail feathers, left-right movement of neck, stretching the beak skywards in an ecstatic posture, and other actions that eventually lead to coition. When an intruder arrives in the male's territory it displays a threatening posture by raising its head and sleekening the plumage. Nestlings and fledglings use specific begging display by quivering their wings and demanding food. In addition, one type of resting and three types of sleeping postures have been observed.

INTRODUCTION

Physical display or posture is one of several means of animal communication, as a wider range of expression is possible by visual rather than vocal, chemical or tactile means. Birds are known to use visual signals (Collias 1943, Armstrong 1965, Butcher and Rohwer 1989). Special postures and movements are often used to display these signals. Many methods have been developed by birds for switching visual signals on and off by movements of the head, body, tail, wings and body feathers (Marler and Hamilton 1966). It is believed that species-specific morphological features of an animal may be ritualized ('ritualization' refers to the evolutionary modification of movements and structure to improve their signal function) and act as sign stimuli to which other members of the species respond instinctively (Krebs and Devies 1987). In the social context, these sign stimuli are termed 'social releasers' e.g. the red spot on the bill of herring gull has all the characteristics of a sign stimulus. In ethological terms, the red spot of the bill releases the begging response of the chick (Tinbergen 1951).

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Visual displays or postures in birds perform a variety of functions. The head-up posture is frequently used in fighting and territorial defence in many passerine families (Marler 1961). Aggressive displays often involve an apparent increase in size (Tinbergen 1959, Marler 1961). The main weapons of many birds are the bill and wings, and these are often maximally presented to the opponent in a 'head-forward' posture (Andrew 1961). Many visual signals are directed partially or entirely towards members of the opposite sex, coordinating reproductive activities. The ornamentation of plumage is widely used by the birds to synchronize the reproductive process and mate acquisition (Mayr 1956, Butcher and Rohwer 1989). Colourful marks on various species, especially on the beak, are used by birds for parent-offspring recognition (Tinbergen 1959).

Despite the rich avifauna in the Indian subcontinent (about 1,228 resident species), our knowledge of displays and postures of Indian birds is scanty and based on fragmented observations made by ornithologists, naturalists and bird watchers (Ali 1996, Ali and Ripley 1998). According to Ali (1996), 'our greatest need today is for careful and rational field work on living birds in their natural environment'. Thus, an attempt has been made to study the types of displays and postures and their sociobiological importance in the Oriental magpie robin *Copsychus saularis*.

Material and Methods

The Oriental magpie robin (Family Muscicapidae, Subfamily Turdinae) is a conspicuously pied black and white bird, distributed throughout the Indian subcontinent, up to about 2,500 m above msl, absent in arid areas and is divided into three races on minor size and colour differences. It is a common plains species, avoiding both dense forest and open bare plain and prefers groves and gardens. The male is glossy black and white with graduated long, white tail, with two central pairs of black feathers. The black portions of the male are replaced by a brownish, slaty grey in female. It is one of the best songsters in a land where singing birds are scarce (Whistler 1949, Ali 1996).

Field observations were made from January 1995 to December 1998 on 33 individuals (24 males and 9 females) in and around Gurukul Kangri University campus, Haridwar (29° 55' N, 78° 8' E). The habitat was composed of gardens and crop fields, divided by hedges and tree rows, while houses/offices were often in close proximity. Data was collected by visiting each site once a week, between early morning and late evening, using a binocular (7 x 50). Displays were recorded with the help of SONY handicam video camera and Pentax still photography camera with telelens (300-600 mm). To determine the information conveyed by a signal, the circumstances in which the signal occurred were examined. The characteristics and components of different displays were defined, analyzing video films and still photographs.

Results

1. **Flight display**: An important display in this species. The male uses flight display in the early phase of the breeding season (i.e. March and April). When a male sees a female in his territory, he flies towards her. Before approaching her, he stalls in flight for a few seconds. In most cases (n=16), the flight display may last for 4-10 sec ($\bar{x}$=7.38 ±0.46). However, in some cases (n=6) it can last for 20 sec ($\bar{x}$=18.83 ±0.55). This distinctive and conspicuous display flight has two components: undulating flight with fully spread wing and tail feathers (Plate 1, Fig. 1) and a highly varied, complex song to attract the female. The male also uses undulating flight with threat calls when predators (spotted owlet, snake, mongoose) appear in his territory.

Kumar, Anil *et al.*: *Copsychus saularis* PLATE 1

Figs (1-4): Magpie robin *Copsychus saularis*, 1: Flight display of male, 2. Tail display of male, 3. Head forward (threat) posture of male, 4. Resting posture during winter.

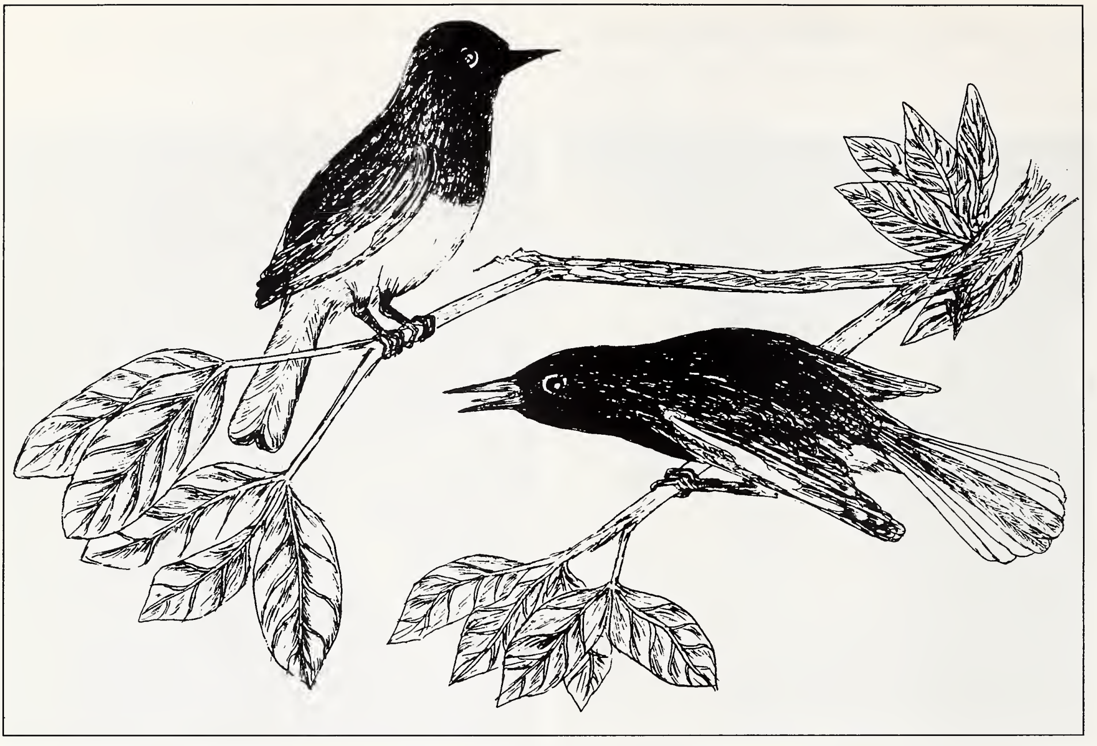

Fig. 1: Courtship display, male magpie robin in front of the female

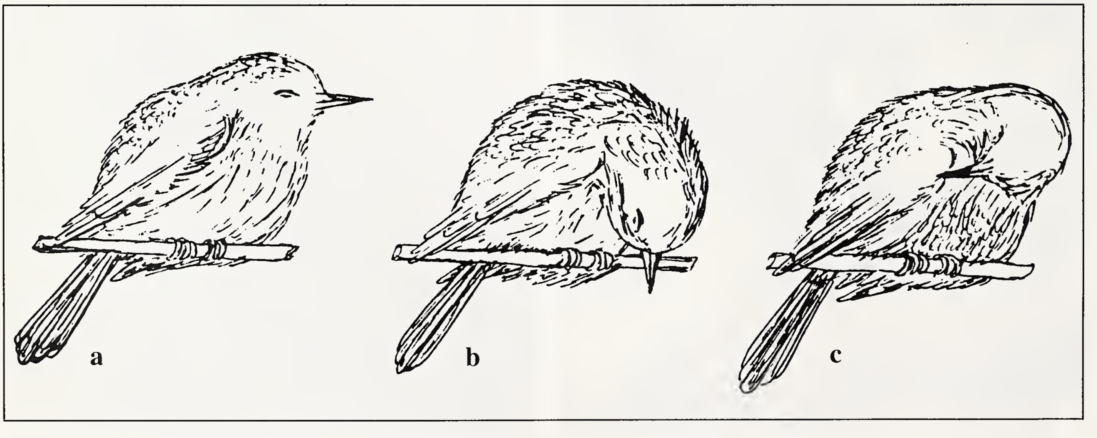

Fig. 2: Sleeping postures exhibited by magpie robin (a) Neck shrinking posture (b) Neck hanging posture (c) Neck turning posture.

2. **Tail posture**: The male magpie robin uses this posture only until mating is completed. He sits on a horizontal perch and fans out his tail (Plate 1, Fig. 2) for about 5 sec. ($\bar{x}$=5.09 ±0.35, n=22), to show the white tail feathers which are normally covered by the black, middle tail feathers. After returning to his normal position, he selects another branch and repeats the posture. The male repeats this posture 4-9 times ($\bar{x}$=5.29 ±0.48, n=24) at a stretch. The male normally shows the dorsal side of his tail feathers. However, sometimes he also exhibits an anterio-ventral side. Most males (n=18) displayed the tail posture after pair formation, but in some cases (n=6) it was prior to pair formation and also when the territory owner saw a female approaching his territory.

3. **Courtship display**: A dance-like display performed by the courting male bird in the presence of a female. There are two types of courtship displays: (A) The male sits on a perch, stretches his head forward and downward, simultaneously displaying his tail feathers. He also moves his neck slightly to the right and left a number of times, simultaneously flapping his wings like a begging juvenile. (B) The male starts walking on a wall with his head towards the female. After walking about a metre, he halts, turns his head up and points his bill towards the sky (at about 60° to the horizontal plane) for 2-4 seconds ($\bar{x}$=2.75 ±0.21, n=12), with his tail outspread. After this, he starts walking towards the female, finally performing the 'A type' display (Fig. 1). The 'A type' behaviour is more common than the 'B type'.

4. **Threat posture**: When an intruder arrives in the territory of a male, the territory owner shows a specific threatening posture (Plate 1, Fig. 3) before chasing and fighting the rival. In this posture, the male turns his head up and sleekens the plumage, facing the rival. If the intruding rival does not escape immediately, a fight follows, in which the submissive individual delivers submissive calls.

5. **Begging display**: The nestlings and fledglings were observed using this display. It is interesting to note that the newly hatched young open their beaks after receiving even a slight jerk, caused by the perching of the parents on any branch of the nesting tree. However, once the nestlings open their eyes, they respond only after seeing the parents. After their wings develop, they shake them to make the display more effective. Begging display is generally accompanied by begging calls.

6. **Resting posture**: In winter, when the magpie robin rests in the day, it curls up its body and fluffs the body feathers into an almost spherical shape (Plate 1, Fig. 4). This posture is adopted by many bird species, to save body heat during winter.

7. **Sleeping posture**: The magpie robin was observed in three types of sleeping postures, i.e. neck hanging posture (NHP), neck turning posture (NTP), and neck shrinking posture (NSP) (Fig. 2). Most individuals (66.4%) use the NTP during sleep — the bird turns its neck so that its shape appears deformed. Predators cannot recognize the bird easily in this cryptic appearance. NHP and NSP also deform the shape of the sleeping bird, protecting it from predators. But NHP (28%) and NSP (5.6%) were used for short duration only. The bird may have been less comfortable in these postures.

8. **Wing drooping display**: In this display, the magpie robin stretches its tail upwards and then droops it in a few steps. Simultaneously, it droops its wings in the same sequence. This posture is observed during the post-breeding phase. Its biological significance, however, is not yet clear.

Discussion

It has been suggested that display flights are directed at females and associated with the male quality, or sometimes function in male-male

interactions to defend territory (Andersson 1982, McGregor *et al.* 1990). The magpie robin exhibits individual differences in song quality (Bhatt and Kumar 1998a b, Kumar 1999) and there are suggestions that these may be associated with variations in strength or fighting ability (Krebs and Devies 1987). When different males engaged in song production exhibit differences in song quality, the female has an opportunity to select a male that exhibits more strength through his song signal than other courting males. In the present study, the magpie robin used flight display in the presence of a female or predator. From this it can be inferred that flight display, like song, also helps the male to show his strength, to attract a female or repel predators. Flight displays have also been reported in other birds like the jay *Garrulus glandarius*. (Goodwin 1956), fantail warblers *Cisticola juncidis* (McGregor *et al.* 1990), and white-throated manakin *Corapipo gutturalis* (Davis 1982, Prum 1986, Gaunt 1994). However, the acoustical features of the song/calls of these species are less varied than magpie robin. Therefore, in these birds with simple song/calls, the development of visual display for mate attraction is understandable, but in species like magpie robin where vocalization is complex and varied, the interpretation of the genesis of flight display is rather difficult. Observations revealed that the male used not only flight display, but also tail display to attract the female. Obviously, this bird has a good repertoire of both vocal and visual signals.

In almost all avian species, courtship behaviour is exhibited by males. The bird may reveal his gaudy nuptial plumage, spread his tail feathers, erect his crest or inflate brilliantly coloured patches, parade, dance, fly with dizzying aerobatics, sing his most fetching songs all this just to impress his prospective mate (Welty and Baptista 1988). Courtship stimulates sexual readiness, not only in the bird being courted, but also in the courting bird, through self stimulation. This reciprocal stimulation may be the chief function of the mutual courtship ceremonies of many colonial birds such as gannets, gulls and penguins. Such stimulation commonly results in the increase of sex hormones in a bird's body, which in turn intensifies courtship display (Welty and Baptista 1988).

The courtship display of magpie robin is simple and takes little time (16 ±3.2 sec, n=4). It is believed that species with complex songs and pronounced territories often have rather simple courtship displays, whereas species with small territories and simple or no songs generally have more elaborate courtship displays. It may be that pronounced territoriality and song serve, in part, to initiate pair formation and maintenance throughout the breeding period. When territories are small and/or songs are absent, displays seem to serve the function of pair bonding. In colonial birds, these displays may continue throughout the nesting cycle as a device to ensure individual recognition between the paired birds (Faaborg and Chaplin 1988).

The threat posture appears to help minimize the cost of territory defence by avoiding chasing/fighting the rival. Like the magpie robin, head-up posture is used by several species of birds for territory defence and fighting (Marler and Hamilton 1966). It has generally been observed that aggressive displays often involve an increase in apparent size. Larger animals dominate smaller ones in many species, and intimidating or repelling signals often maximize this particular property (Tinbergen 1959, Marler 1961). The 'head-forward display' is used not only for threatening, but also for pairing with females by many male finches (Hinde 1956).

Begging display is common in birds, and almost every avian nestling uses it to demand food from parents (McFarland 1995a, b, Alcock 1988). Our causal observations revealed that higher frequency of wing-movement (quivering)

might stimulate parents to feed young ones more frequently as compared to low frequency quivering. In addition, it may strengthen the flight muscles of the wings. The inside of the beak of a magpie robin nestling is bright yellow, which helps parents locate the exact position of the nestlings' mouths while feeding them in the dark environment of the nest hole/nest-box.

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THE POPULATION DYNAMICS AND CONSERVATION OF GOLDEN LANGUR[1]

A. Srivastava[2,3], M. Baruah[4] and S.M. Mohnot[2]

Key words: Endangered species, golden langur, demography, conservation, distribution

Localized distribution between River Manas in the east, Sankosh in the west and the Brahmaputra in the south have confined the golden langur (*Trachypithecus geei*), to an extremely small patch of forest bordering India and Bhutan, making it one of the most seriously endangered primates of India. Data on population dynamics collected in four years, 1994 to 1997, from four focal groups inhabiting the rubber plantation of Nayakgaon, Assam, have been presented here. An average group size of 7.8 (range 7.0 to 8.4) individuals was recorded. Of the total 151 individuals counted, 27% were adult males, 48% were adult females and 23% were immature (juveniles and infants). The adult sex ratio was 1.3 to 2.3 adult female for each adult male. The average group size and adult sex ratio of the golden langur declined during the study period. However, the number of births per female increased from 0.31 to 0.44/year. A low percentage of juveniles and infants suggest that the population is heading for a decline. The majority of the groups had more than one adult male, suggesting a promiscuous mating system. Small group sizes, isolated distribution, few infants and juveniles, and degrading habitat are all causes for concern. It is not clear from the available data if the increase in number of births per female per year is due to higher mortality of infants or due to greater access to mating partners. Nevertheless, these demographic trends indicate a population decline.

Introduction

Golden langurs (*Trachypithecus geei*) are naturally found in a very small area bordering India and Bhutan. Its distribution lies north of the Brahmaputra river and is bounded on the east by the Manas river and in the west by the Sankosh river. Gee (1955) and Khajuria (1956, 1962) provided the first record of its morphology and distribution. However, the taxonomic status remained disputed until Biswas (1967) provided a detailed account. Although there have been several attempts to work out the true distribution range and total population, little information was generated on the distribution and status of this species in India and Bhutan (Gee 1961, Wayre 1968, Mukerjee 1978, Subba 1989, Choudhury 1992, Wanghuk 1995). Since 1994, extensive surveys have been conducted in northeast India by the first author and the Indo-US Primate Project team to work out the status and distribution of primates. An intensive survey was carried out over 1,500 sq. km of forest in western Assam, for its distribution (Srivastava 1997). Most of these surveys provided information on distribution (Choudhury 1992, Subba 1989, MacKinnon 1991), total population (Wangchuk 1995), and group structure (Mukerjee and Saha 1974, Mukerjee *et al.* 1997). The species is placed under Schedule-I of the Indian Wildlife (Protection) Act (1972) and in Appendix-I of CITES. No serious attempt has been made to collect data on population dynamics so as to draw a conservation plan for this endangered species (Srivastava 1996). In order to fill this gap, the present study was carried out at Nayakgaon on selected groups of golden langur for over four years.

The present paper has two aims — to present the population dynamics of the selected groups in the study area and to discuss the long-term conservation strategies for this species in the light of demographic data.

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Study Area

There is a *gurukul* (traditional school) located 15 km east of Abhayapuri town in western Assam, surrounded by natural forest and rubber plantation. The second author was a permanent resident of this *gurukul* during the study period. Four groups of golden langur were initially identified during December 1994, and their home range, preferred roosting trees and feeding sites were observed. These groups dwell in the Abhaya Rubber Plantation, Nayakgaon Kokrajhar district, Assam, which covers 174 ha of rubber plantation and natural sal forest. The groups have been seen in the area since 1985, when rubber plantations were first started. It is quite likely that these groups lived here in the natural habitat and continued to survive in the habitat altered from predominantly natural moist deciduous sal forest into rubber plantation. These groups are familiar with humans and come into regular contact with local residents and rubber tappers. Hunting is strictly prohibited, but natural predators are common in the area. Average tree canopy cover in the area is over 75% and average tree height is 20 m. Langurs do not get feed from people and do not come to human habitation.

Study Methods

All individuals of the group were identified and focal groups were contacted many times during the census period to get perfect counts. As a rule, individuals moved in single file, and

Table 1
GROUP SIZE AND AGE-SEX COMPOSITION OF FOUR GOLDEN LANGUR FOCAL GROUPS BETWEEN 1994 AND 1997

Census Date	Group Name	Adult Male	Adult Female	Ad. Sex Ratio	UnID	Juvenile	Infant	Total	G. Total
December 15, 1994	SS	2	4	1:2	-	-	3	9	
	MF	2	5	1:2.5	-	-	-	7	
	NEC	2	5	1:2.5	-	-	1	8	
	NEM	1	2	1:2	-	-	1	4	28
March 11, 1995	SS	2	6	1:3	-	-	1	9	
	MF	2	5	1:2.5	-	-	1	8	
	NEC	2	4	1:2	-	-	-	6	
	NEM	2	4	1:2	-	-	4	10	
	BA	1	2	1:2	4	-	2	9	42
May 30, 1996	SS	2	4	1:2	-	1	2	9	
	MF	2	3	1:1.5	-	-	-	5	
	NEC	2	4	1:2	-	-	2	8	
	NEM	4	4	1:1	-	-	4	12	
	BA	3	2	1:0.75	-	2	2	9	43
May 17, 1997	SS	2	5	1:2	-	-	2	9	
	MF	2	3	1:1.5	-	-	1	6	
	NEC	2	4	1:2	-	-	2	8	
	NEM	2	4	1:2	-	-	2	8	
	BA	4	2	1:0.5	-	-	1	7	38

Abbreviations: SS = South Side; MF = Middle Forest; NEC = North East Corner; NEM = North East Middle;
BA = Bukanjhora Area: UnID = Unidentified

therefore, almost 100% reliable counts could be obtained from a convenient observation post in the forest during group movement. When the focal groups were contacted, individuals were counted and classified as adult males, adult females, juveniles and infants. Infants were further classified as infant-I (fur colour orange) and infant-II (fur colour creamy-white). During December 1994, four groups were located, but in successive counts during March 1995, one additional group was also located. All groups located had their preferred roosting sites, and therefore it was not difficult to locate them again during the next census. The process was repeated in May 1996 and May 1997.

Results

During the December 1994 census, 4 groups were recorded. Group size and composition with a total population between December 1994 and May 1997 are given in Table 1. In 1994, the smallest group contained 4 and the largest 9 individuals, with an average group size of 7 individuals. Out of a total of 28 individuals counted, 25% were adult males, 57% adult females, 18% immature (juveniles and infants), with a socionomic ratio of 4.6 : 1 (adult : immature). The adult sex ratio was 2.0-2.5 females to 1.0 male. The majority of groups had more than one adult male.

During the March 1995 census, an additional group was located besides the four identified focal groups. This brought the total population to 42, with an average group size of 8.4 individuals. Of these, 21% were adult males, 50% were adult females, 19% were immature (juveniles and infants), with a socionomic ratio of 4 : 1. The adult sex ratio was 2 to 3 females for each male. The same focal groups were recounted in May 1996 and in May 1997 to record the change in the population.

Between May 1996 and May 1997, the following changes were observed: The total population declined slightly from 43 to 38 individuals. The average group size declined from 8.4 to 7.6. Similarly, the adult sex ratio changed from 0.75-2 to 0.50-2.5 females for each male. A solitary male was also observed during the May 1997 census (Table 2). However, the sex ratio declined from 2.3 females, in Dec. 1994 to 1.5 in May 1997, the number of infants per female increased from 0.31 to 0.44/year. All births were observed during the monsoon, between July and October, and there was no birth peak.

Model of Golden Langur Population Dynamics: Census data can often be used to identify factors that may determine the abundance of species, which is clearly essential for the formulation of an effective conservation plan. In order to present our findings in a broader perspective, we used a published demographic model to prepare an effective conservation plan for this species. Instead of attempting to develop a species-specific life table analysis, we adopted

Table 2

VARIATIONS IN GROUP SIZE AND AGE/SEX COMPOSITION IN A POPULATION OF GOLDEN LANGUR DURING 1994-97

Census Date	Total No. of Groups	Total No. Individuals	Average Group size	Adult Male	Adult Female	Juvenile Infants	% of Adults
December 94	4	28	7.0	7	16	5	82.1
March 95	5	42	8.4	9	21	8	71.4
May 96	5	43	8.4	13	17	13	69.8
May 97	5	38	7.6	12	18	8	78.9

a general model based upon the Leslie matrix and modified by Dobson and Lyles (1989). This model requires age-dependent estimates of survival and fecundity. This has been applied to several primate populations (Altmann *et al.* 1985). As suggested by Dobson and Lyles (1989), we avoid the complexity of a fully age-structured model by noting that like most primate species, golden langur females' age at first reproduction, is approximately three times the average inter-birth interval. The average inter-birth interval recorded elsewhere for the same species was two years (Srivastava, A. unpubl. data). The population is divided into three stages: Infants = I; Juveniles = J; and Adults = A (also see Tables 2 and 3).

During the four years of this census, we have noted the changes in the structure of the study population, which fluctuated within the normal range. However, the higher proportion of adults in the population is a matter of great concern (Table 3). The proportion of adults in the population was nearly 70%, which indicates a mature population. This means that the study population will not have enough recruitment for the replacement of reproducing individuals in the coming years. The low percentage of juveniles and infants and high number of adults suggest that the population is declining. The majority of groups had more than one adult male, suggesting a promiscuous mating system. Decline in the number of females per male during the study period indicates loss of breeding opportunities.

After detailed analysis of a large data set for primate populations, Dobson and Lyles (1989) suggested an integrated model with two important conclusions:

1. Primate populations will tend to collapse when the survival of adult females falls below 70% per interbirth interval.

2. Species that tend to live in aggregated groups with promiscuous mating will establish and maintain themselves at smaller population densities than species with more solitary and monogamous habit.

The golden langur does not meet both these criteria, and therefore, does not face immediate danger of extinction. However, if habitat loss continues at the same pace, this species will eventually lose its resource base and may go extinct, as already shown by the decrease in number of adult females to male from 2.3 in Dec. 1994 to 1.5 in May 1997. This is further supported by the fecundity data (Table 4). It is not clear whether the increase in number of births per female per year was due to higher infant mortality or to greater access to mating partners (increased males per female). Nevertheless, these demographic trends indicate a population decline.

Discussion

Golden langurs occupy moist evergreen, dipterocarp, riverine and moist deciduous forests. Their localized distribution between River Manas in the east, Sankosh in the west and Brahmaputra in the south confines them to a very small patch

Table 3

ADULT MALE-FEMALE SEX RATIO AND BIRTH RATE BETWEEN 1994 AND 1997

Census Date	Total No. of Groups	Adult male/ Adult female	Total Adult Males	Total Adult Females	Total Infants	Birth Rate (birth/female/year)
December 94	4	1 : 2.3	7	16	5	0.31
March 95	5	1 : 2.3	9	21	8	0.38
May 96	5	1 : 1.3	13	17	10	0.59
May 97	5	1 : 1.5	12	18	8	0.44

TABLE 4
GOLDEN LANGUR LIFE HISTORY DATA

Life History Parameters	Observed and/or estimated Values (explanation below)
Type of Population	Natural and Disturbed
Study Years	1994 - 1997
Number Studied	28 - 43
Birth Season	July - October[b]
Inter birth interval	Two Years[b]
Age at first reproduction	Six years[a]
Birth rate (birth/female/year)	0.31 - 0.59
Survival to age 1	0.30 - 0.42[a]

[a] = based on Dobson & Lyles (1989) model.
[b] = Srivastava, A. observations on free-ranging population of golden langurs.

of forest bordering India and Bhutan. Of the entire golden langur population, 93% is confined to these contiguous forests. However, remaining 7% population is found in several small isolated reserves (Srivastava 1997). Recent studies indicate that their distribution has been reduced significantly (Mukerjee and Southwick 1997) and their population consists of very small groups with a higher proportion of adults and very few juveniles and infants (Srivastava 1997). It has been estimated that there are not more than 1,500 individuals in India. A larger population exists in Bhutan, estimated at over 4,340 individuals, but these figures are based on an extrapolation from 58.5 sq. km. study area in Black Mountain National Park (Wangchuk 1995). The total known range of the golden langur in both Bhutan and India is less than 30,000 sq. km., and much of this is not suitable habitat (Mukerjee and Southwick 1997).

The low population size and group size of the golden langurs are comparable to some of the other critically endangered langurs of the world, such as the golden-headed langur (*T. franscoisi poliocephalus*), Delacour's langur (*T. delacouri*) (Nadler 1996) and the Tonkin snub-nosed langur (*Rhinopithecus avunculus*) (Cox *et al.* 1994). For such small and fragmented groups, the chances of long-term survival are slim. Although, it has been suggested that this species is rarely seen in altered habitats, our observations in the rubber plantation suggest that the golden langur can survive and reproduce in altered habitats under protection. Therefore, it would seem unwise to expend all conservation efforts on a small number of sites. Instead, we suggest a balanced strategy giving equal weight to small, isolated, and altered habitats as well.

Since there is no hunting pressure and most people on either side of the international boundary respect primates in particular, the species has good chances of survival in the present habitat. We believe that a vigorous effort at conservation can protect the remaining habitats, and by upgrading the status of these habitats, isolated populations can be linked by forest corridors to prevent genetic fragmentation of the population.

Further studies on destruction of golden langur habitats are needed to estimate demographic rates and shapes of recruitment functions. How behavioural mechanisms affect the population dynamics remains a challenge.

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■ ■ ■

STUDIES ON THE SYSTEMATICS AND DISTRIBUTION OF PRAWNS IN ASSAM[1]

N.K. Dutta[2]

(*With nine text-figures*)

Key words: *Caridina weberi* de Man, *Macrobrachium altifrons* (Henderson), *M. assamensis* (Tiwari), *M. birmanicum choprae* (Tiwari), *M. dayanum* (Henderson), *M. lamarrei* (H. Milne-Edwards), *M. malcolmsonii* (H. Milne-Edwards)

The family Atyidae (Decapoda : Crustacea) of Assam has *Caridina weberi* de Man of the genus *Caridina* and eight species of the genus *Macrobrachium* namely *Macrobrachium altifrons* (Henderson), *M. assamensis* (Tiwari), *M. lamarrei* (H. Milne-Edwards), *M. malcolmsonii* (H. Milne-Edwards), *M. menoni* (Agarwal) and *M. tiwari* (Agarwal) of Family Palaemonidae recorded from different districts of Assam.

Introduction

The biology and fishery of prawns has gained considerable attention, due to their great economic importance. Prawns are caught round the year. However, the peak catch shows a definite seasonal trend in commercially important prawn landing areas. In the north-eastern region of India in general and Assam in particular, the peak season is from September to February. Various authors reported on the taxonomy and distribution of freshwater, estuarine and marine prawns (Henderson and Matthari, 1910; Tiwari, 1947; Holthuis, 1950; Yaldwyn, 1955; Kunju, 1956; Holthuis and Roas, 1965; Yaldwyn, 1966; George, *et al.* 1968; Koshy, 1969; Yaldwyn, 1971, 1973; Agarwal, 1976). But in this context, there is little information on the freshwater prawns of Assam. In view of this, the present study was undertaken.

Material and Methods

Prawns belonging to Family Atyidae and Palaemonidae were collected regularly in different districts of the state of Assam, and were obtained from fishermen's catches. They were brought to the laboratory, cleaned and preserved in 8-10% formaline.

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Results

The collection from Assam comprises of nine species.

Caridina weberi de Man 1892.
(Fig. 1)

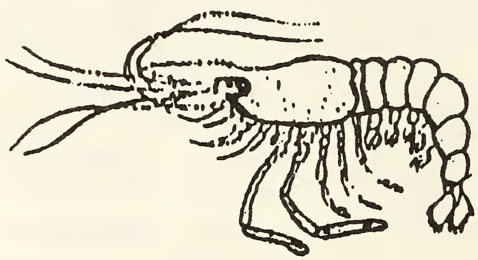

Fig. 1: *Caridina weberi* de Man

Collection localities; Goalpara district: Dipul beel, 1♂, 2♀, TL 18-20 mm; Kamrup district: Jalukbari and Kulsi, 2 ♂, 1♀, TL 15-24 mm; Nowgaon district: Kolong R., 2♂ d, 3 ♀, TL 15-17 mm; Sibsagar district: Namdang R. and Joysagar 4♂, 3 ♀, TL 17-18 mm.

Diagnostic features: Rostral formula (RF): 15-19/4; carapace pigmented. Apex of antennal scales, pointed to slightly oval; spines on the 5th peraeopod absent altogether, but spines present on the 3rd and 4th peraeopods. 1st peraeopod: carpus = chela, carpus > merus. 2nd peraeopod: merus = carpus, carpus > chela.

Maximum size 24 mm.

Macrobrachium altifrons (Henderson)
(Fig. 2)

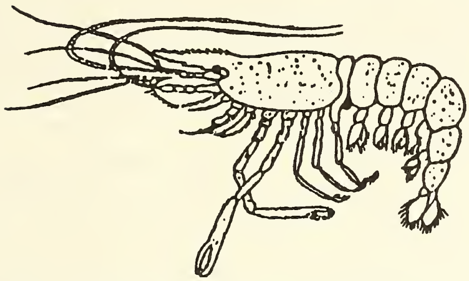

Fig. 2: *Macrobrachium altifrons* (Henderson)

Collection localities: Kamrup district: Sonapur, 2 ♂, 3 ♀, TL 43-46 mm.; Pandu, Maligaon, 8 ♂, 5 ♀, TL 44-47 mm; Goalpara district; Dhubri, 2 ♂, 3 ♀, TL 45-46 mm, Karbi Anglong district: Jamuna R., 2 ♂, TL 46 mm; Sibsagar district: Sibsagar market, 5 ♂, 6 ♀, TL 43-45 mm.

Diagnostic features: RF 10-12/3; Ant. scale pointed. Apex horizontal to slightly upturned, convexity starts after 1/3rd length of its origin; 3-4 teeth on carapace; teeth are sub-erect. 1st peraeopod: finger = 1/2 carpus; ischium, merus, palm and finger are hairy. 2nd peraeopod: unequal or subequal, palm ≥ finger, palm broader than carpus, 2-3 blunt teeth with 6 tubercles on immobile finger, but in mobile fingers 3-4 unequal teeth at irregular intervals. Cutting edge of mobile fingers with 4 tubercles instead of 5 or 6.

Maximum size 47 mm.

Macrobrachium assamensis (Tiwari)
(Fig. 3)

Collection Localities: Kamrup district: Pagladia R. near Uttar Kuchi, Chowki and Nabasti, 1♂, 6♀, TL 40-76.2 mm; Baralia R. near Rangia, 40♂, 20♀, TL 42-73 mm; Kukurmara beel, 1♂, 9♀, TL 43-68 mm; Tihu, Boko near Soigaon, Houli near Barpeta, Kulsi R., Deeper beel near Jalukbari and Guwahati, 32♂, 23♀, TL 31-71 mm; Sibsagar district Namdang R. Gaurisagar, 50♂, 45♀, TL 51-77 mm; Dibrugarh district: Dilli R. near Namrup, Dibru R. near Rajgarh, 25♂, 36♀, TL 45-65 mm; Lakhimpur district. Dhokuakhana, 20♂, 15♀, TL 49-50 mm; Cachar district: Silchar, 5♂, 8♀, TL 42-45 mm.

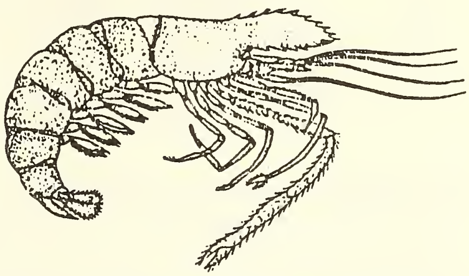

Fig. 3: *Macrobrachium assamensis* (Tiwari)

Diagnostic features: RF 8-10/2-4; RL > Antennal scale. Antennal scale-oval, carapace highly pigmented. Wide gap between 1st & 2nd, 2nd & 3rd and 3rd & 4th teeth on dorsal edge of rostrum. Antennal scale somewhat conical to oval. 1st peraeopod: Carpus ≥ chela, Carpus > merus. 2nd peraeopod: merus ≥ carpus. Non-chelate leg: all segments hairy except merus; propodus = merus; 3 equal teeth on Im. F., and 1 large and 2 small teeth on M.F., apex of telson round to acute.

Maximum size 77 mm.

Macrobrachium birmanicum choprae (Tiwari)
(Fig. 4)

Collection localities Kamrup district: Bijlee beel, 2♂, 1♀, TL 95-110 mm, Brahmaputra R. 5♂, 5♀, TL 85-165 mm, Darrang district: Jamuguri beel near Tezpur, Tezpur market, 10♂, 15♀, TL 69-165 mm; Sibsagar district: Dekhow R. 22♂, 33♀, TL 65-170 mm, Lakhimpur district. Dhokuakhana 5♂, 8♀, TL 84-100 mm; Dibrugarh district Brahmaputra R. near Assam Medical College,

24♂, 30♀, TL 79-167 mm; Cachar district: Karimganj 25♂, 24♀, TL 70-160 mm.

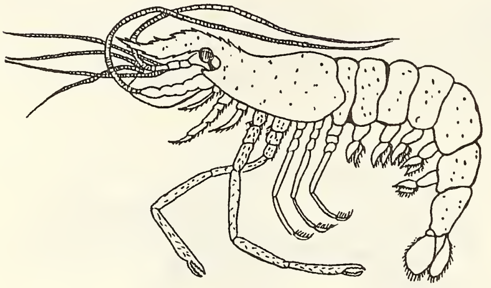

Fig. 4: *Macrobrachium birmanicum choprae* (Tiwari)

Diagnostic features: RF 11-12/4-5; Apex of antennal scales pointed; rostrum somewhat long depending on body size and protrudes in front of body, nearly reaching antennal scale. Carapace smooth in young ones, rough in adult and slightly pigmented. 1st peraeopod: exceeds Ant. scale by chela, 2/3rd of the carpus, carpus twice as long as chela, 2nd peraeopod: spinules larger only on undersurface of merus; ischium rod-like, not laterally grooved; merus = carpus > palm. One conical and one blunt tooth on M.F. with 4 to 5 tubercles. Apex of finger translucent.

Maximum size 170 mm.

Macrobrachium dayanum (Henderson)
(Fig. 5)

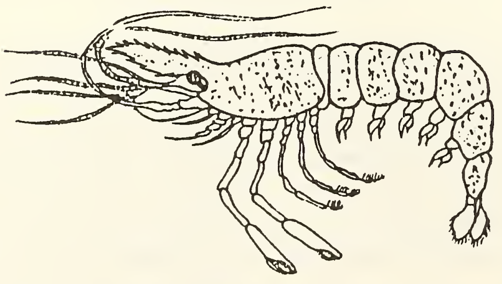

Fig. 5: *Macrobrachium dayanum* (Henderson)

Collection localities: Kamrup district: Pagladia R. Chowki & Naubasti, Raumari beel, Satdala beel, Rangagora near Changsari, Depargaon near Kumanadi R., Moranadi R. near Dimoo, Deeper beel near Guwahati, Kukurmara beel near Guwahati, Kapla beel, Boko near Soigaon, Jalukbari, Guwahati, Kulsi R. 37♂, 24 ♀, TL 26-92 mm; Darrang district: Jamuguri near Tezpur, Raumari beel, Mora Boroli R., Mongoldoi R. near Mongoldoi, Urang near Dhekiajuli, 21♂, 18♀ TL 41-71 mm; Nowgaon district: Jagiroad, 13♂, 20♀, TL 26-68 mm; Karbi-Anglong district: Kapili R., 2♂, 4♀, TL 55-69 mm; Cachar district: Kaliganj, Karimganj, Silchar proper, 22♂, 28♀, TL 35-55 mm; Sibsagar district: Longsai beel, Pohugar near Gaurisagar, Namdang R. near Kaloogaon, Ranganadi R., Janji R., Kakodunga R., 43♂, 35 ♀, TL. 18-89 mm; Lakhimpur district: Corella beel, 7♂, 9♀, TL 26-75 mm; Dibrugarh district: Namrup, Dibrugarh proper near Brahmaputra R., 22♂, 20♀, TL 39-68 mm; Lakhimpur district: Dhakuakhana 12♂, 9♀, TL 37-52 mm.

Diagnostic features: RF 7-11/5-9; apex of ant. scale pointed. Cavity-between first and second teeth on ventral edge of rostrum. Cervical sulcus moderately developed, gastro-orbital carina well developed, Carapace highly pigmented. 1st peraeopod: merus = ischium; ischium, merus, palm and finger hairy. 2nd peraeopod: palm ≥ finger, carpus = merus, ischium and palm-rod-like. Non-chelate legs: all segments hairy; ischium > carpus; Im. F. with 2-3 conical teeth having 7-8 minute spines. M.F. with 3 equal conical teeth having 5 minute spine-like processes.

Maximum size 92 mm.

Macrobrachium lamarrei (H. Milne-Edwards)
(Fig. 6)

Collection localities: Kamrup district: Pagladia R., Deeper beel near Guwahati,

Brahmaputra R. near Maligaon, Fancy Bazar, Guwahati, Bhalukmara beel, Kahikusi, Boko near Soigaon, Hatipara beel, Chetolijan near Nalbari, 21♂, 18♀, TL 21-55 mm; Goalpara district: Dipo R., Dhubri, 10♂, 70♀, TL 33-51 mm; Darrang district: Raumari beel near Tezpur, 7♂, 5♀, TL 36-42 mm; Nowgaon district: Nowgaon proper, 4♂, 10♀. TL 36-44 mm; Cachar district: Karimganj, Silchar proper, Chatla, Hawar beel, near Silchar, 36♂, 67♀, TL 35-65 mm.; Sibsagar district: Namdang R. near Kaloogaon, Bhougdoi R., Kakodunga R., Kaziranga 56♂, 40♀, TL 17-58 mm; Dibrugarh district: Dibgrugarh proper near Brahmaputra R., 50♂, 43♀, TL 40-57 mm; Lakhimpur district: Dhakuakhana, 10♂, 11♀, TL 18-30 mm.

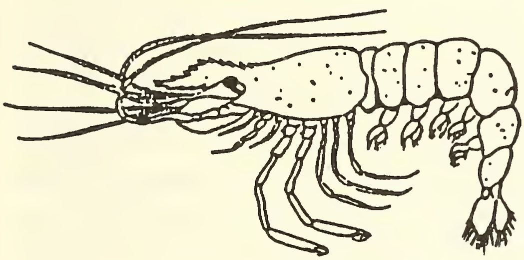

Fig. 6: *Macrobrachium lamarrei* (H. Milne-Edwards)

Diagnostic features: RF 7-11+4-8, carapace slightly pigmented. Apex of ant. scale slightly oval. Rostral length > Ant. scale, teeth on dorsal edge present throughout the rostrum; cervical sulcus well-developed, gastro-orbital carina (GOC) highly developed, adrostral sulcus not distinct. 3rd maxillipeds short, only base of dactylus hairy. 1st peraeopod: carpus = merus, finger = palm. 2nd peraeopod: merus > carpus. Ischium rod-like, Im. F. inwardly curved, teeth almost equidistant from each other. M.F.: 5 minute teeth. Carpus of second cheliped twice as long as chela. Chelate leg: teeth equidistant from each other.

Maximum size 65 mm.

Macrobrachium malcolmsonii (H. Milne-Edwards)
(Fig. 7)

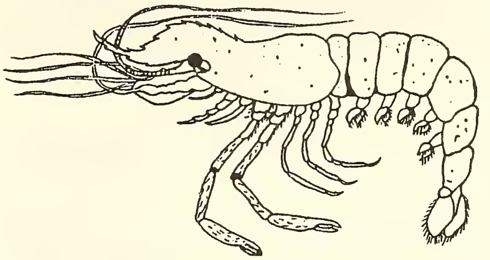

Fig. 7: *Macrobrachium malcolmsonii* (H. Milne-Edwards)

Collection localities: Kamrup dist: Brahmaputra R. near Maligaon and Fancy Bazar, Guwahati., 8♂, 7♀ , TL 36-60 mm, Darrang dist: Brahmaputra R. near Tezpur, Orang near DekiaJuli, 11♂, 9♀, TL 42-48 mm; Cachar dist: Fakira bazar near Bilchar, 12♂, 10♀, TL 45-58 mm; Sibsagar dist: Dekhow R., Bhougdoi R., 12♂, 10♀, TL 35-41 mm; Dibrugarh dist: Brahmaputra R., Naharkatia, 12♂, 13♀, TL 46-58 mm.

Diagnostic features: RF 8-11+1-3/4-7; apex of Ant. scale conical. Rostral length = antennal scale. On dorsal edge of rostrum, convexity starts behind orbit, becomes maximum above orbit, gradually declines, becomes straight and slightly upturned at the tip. 1st and 2nd proximal teeth and last two more widely spaced. 3rd maxilliped reaches 1/3rd of ant. scale, dactylus and carpus hairy. 1st peraeopod: ischium < chela. 2nd peraeopod: ischium < merus, merus > carpus, finger > merus. Non-chelate leg: dactylus and propodus hairy.

Maximum size 60 mm.

Macrobrachium menoni (Agarwal)
(Fig. 8)

Collection localities: Kamrup district: Deeper beel, 8♂, 5♀, TL 32-33 mm.; Goalpara district: Dipo,. 1♂, 1♀, TL 34-36 mm; Cachar district: Chatla Hawar beel, 8 km south of Silchar, 5♂, 3♀, TL 62-67 mm.

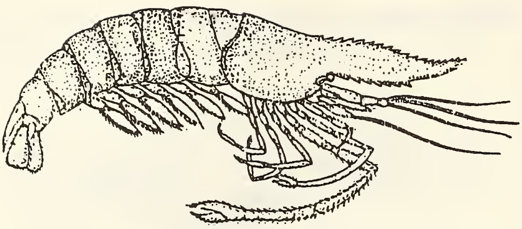

Fig. 8: *Macrobrachium menoni* (Agarwal)

Diagnostic features: RF 15-16/7-8; carapace slightly pigmented. Upper margin of rostrum with convexity just behind eye, concavity in front of eye; tip of rostrum horizontal or slightly inclined and lowered further. Ant. scale oval. 3rd maxilliped almost reaches tip of Ant. scale, carpus and dactylus hairy. 1st peraeopod: ischium=chela. 2nd peraeopod: merus < carpus, carpus twice the length of palm.

Maximum size 67 mm.

Macrobrachium tiwari (Agarwal)
(Fig. 9)

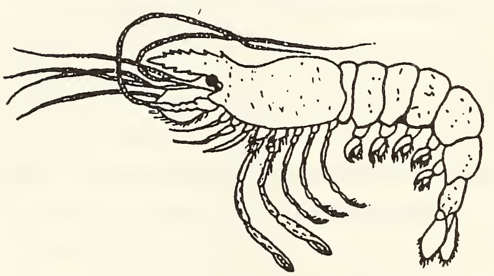

Fig. 9: *Macrobrachium tiwari* (Agarwal)

Collection localities: Kamrup district: Maligaon near Guwahati, 2♂, 3♀ TL 56-58 mm; Goalpara district. Dipol 2♂, 4♀, TL 32-33 mm,; Karbi-Anglong district: Jamuna R., 2♂, 1♀, TL 36-39 mm.

Diagnostic features: RF 5-7/2-5; Carapace slightly pigmented. Apex of ant. scale slightly oval. Rostral length > Antennal scale, wide gap between 4th & 5th, 5th & 6th rostral teeth and 6th & 7th rostral teeth, 3 teeth on carapace. Cervical sulcus highly developed, gastro-orbital carina moderately developed, adrostral sulcus less distinct. 1st peraeopod: carpus ≥ merus; propodus and dactylus hairy. 2nd peraeopod: carpus ≥ merus ≥ ischium, palm > finger. In Im. F. presence of tubercles with 3 equal teeth; 1-2 teeth on M.F. Non-chelate leg: 3rd, 4th, 5th propodus ≥ merus.

Maximum size 58 mm.

Conclusions

These observations on the distribution and taxonomy of Atyidae and Palaemonidae of Assam reveal some interesting findings. The RF of *Caridina weberi* de Man was so far known as 15-17/4. The present study shows an increase to 15-19/4. The RF of *Macrobrachium assamensis* was 9-11/3-6, also all segments hairy, but present study indicates RF 8-10/2-4 and all segments, except merus, hairy. In ealier descriptions of the first peraeopod in *M. dayanum* (Henderson), merus was described as longer than ischium, the ischium and fingers with tuft of setae. But this study shows that merus is equal to ischium, and ischium, merus, palm and fingers are all hairy.

The RF of *M. lamarrei* (H. Milne-Edwards) was reported as 7-10+1-2/4-7, it is 7-11/4-8 in the present study.

In the chelate leg, particularly in the immobile fingers, wide gaps are found between 2nd & 3rd, 3rd & 4th teeth, but in this study, the teeth are found equidistant from each other.

The rostrum of *M. birmanicum choprae* (Tiwari) was so far found to be short and nearly reaching the antennal scale, but here the rostrum is somewhat long, depending on body size, and mostly protruding in front of the body. The spinules of the second peraeopod were recorded as larger on the underside of merus and carpus, but the present observation shows the occurrence of larger spinules only on the underside of the merus.

TABLE 1

DISTRIBUTION OF THE DECAPOD CRUSTACEANS OF THE GENERA *CARIDINA* AND *MACROBRACHIUM* IN ASSAM

Species	Goalpara	Kamrup	Darrang	Nowgaon	Karbi-Anglong	Cachar	Sibsagar	Lakhimpur	Dibrugarh
Caridina weberi de Man	+	+	A	+	A	A	+	A	A
Macrobrachium altifrons (Henderson)	+	+	A	A	+	A	+	A	A
M. assamensis (Tiwari)	A	+	A	A	A	+	+	+	+
M. birmanicum choprae (Tiwari)	A	+	+	A	A	+	+	+	+
M. dayanum (Henderson)	A	+	+	+	+	+	+	+	+
M. lamarrei (H. Milne-Edwards)	+	+	+	+	A	+	+	+	+
M. malcolmsonii (H. Milne-Edwards)	A	+	+	A	A	+	+	A	+
M. menoni (Agarwal)	+	+	A	A	A	+	A	A	A
M. tiwari (Agarwal)	+	+	A	A	+	A	A	A	A

TABLE 2

A KEYTO THE IDENTIFICATION OF THE SPECIES OF THE GENUS *CARIDINA* AND *MACROBRACHIUM* STUDIED

Character	*C. weberi*	*M. altifrons*	*M. assamensis*	*M. b. choprae*	*M. dayanum*	*M. lamarrei*	*M. malcolmsonii*	*M. menoni*	*M. tiwari*
Rostral formula	15-19/4	10-12/3	8-10/2-4	11-12/4-5	7-11/5-9	7-11/4-8	8-11+1-3/4-7	15-16/7-8	5-7/2-5
Antennal scale	pointed to sightly oval	pointed	oval	pointed	pointed	slightly oval	conical	oval	slightly oval
Carapace	pigmented	unpigmented	highly pigmented	slightly pigmented	highly pigmented	slightly pigmented	unpigmented	slightly pigmented	slightly pigmented
1st peraeopod	carpus = chela carpus > merus	finger = ½ carpus	carpus ≥ chela carpus > merus	carpus twice the chela	merus = ischium	carpus = merus	ischium < chela	ischium = chela	carpus ≥ merus
2nd peraeopod	merus = carpus carpus ≥ chela	palm ≥ finger	merus ≥ carpus	merus = carpus ≥ palm	palm ≥ finger; carpus = merus	merus > carpus	ischium < merus merus > carpus	merus < carpus	propodus ≥ merus
Maximum length	24 m	47 m	77mm	170 mm	92 mm	65 mm	60 mm	67 m	58 mm

The taxonomy of the fresh water prawns *Cardina & Macrobrachium* have been very confusing due to the great morphological plasticity of this group showing considerable intra-specific variation over shadowing the genetic affinities between related species. Considering the practical difficulties encountered in the present study, a key is prepared and given

The apex of the rostrum of *M. altifrons* (Henderson) was recorded as inclined downwards or horizontal, the convexity starting after ¼th the length from its origin and with 2 teeth on the carapace. In the present investigation, how-ever, the apex is horizontal to slightly upturned. and the convexity starts after 1/3rd the length from its origin, with 3-4 teeth on the carapace.

The RF of *M. menoni* (Agarwal) was recorded as 15/8, but the present study extends its range to 15-16/7-8. From previous records, in *M. malcolmsonii* (H. Milne-Edwards) RF was recorded as 9-11+1-2/4-7, but this study extends its range to 8-11+1-3/4-7. On the dorsal edge of the rostrum, according to previous study, convexity starts above the orbit, then gradually declines and straightens and becomes pointed at the tip; but here it is found that convexity starts behind the orbit, is maximum above the orbit, gradually declines, becomes straight and slightly upturned at the tip.

The RF of *M. tiwari* (Agarwal) was so far known as 5/5.The present study extends its range to 5-7/2-5. The palm of the second peraeopod was recorded as equal to finger, but here the palm is found to be longer than the finger. A key to the identification of the species discussed is given in Table 2.

The state of Assam can be divided into eastern and western zones, with Guwahati as the central zone. Upper Assam is the eastern zone, including Sibsagar, Lakhimpur, (Cachar is deleted as it is too far south) and Dibrugarh districts, from where large numbers of *M. dayanum, M. assamensis, M. lamarrei* and *M. birmanicum choprae* have been collected. From this collection it is assumed that such species are available both in lower and upper Assam. *M. assamensis, M. dayanum* and *M. birmanicum choprae* are also extensively recorded from Lakhimpur, where they were not previously recorded. Similarly, *M. lamarrei,* which was restricted to Kamrup and Cachar, has been extended almost uniformly over Assam covering all districts except Karbi Anglong. Goalpara and Karbi-Anglong districts were not recorded as sites for *M. altifrons* and *M. tiwarii*, hence they are new locality records. Similarly, Goalpara and Kamrup districts are new distributional localities for *M. menoni*; Cachar, Sibsagar and Dibrugarh for *M. malcolmsonii* and Kamrup, Nowgaon and Sibsagar for *Caridina weberi* respectively (Table 1).

Thus, from the previous and present studies, it is concluded that *M. dayanum* and *M. lamarrei* are extensively found in all districts and have cosmopolitan distribution in Assam, whereas other species are sparsely distributed.

Ackowledgements

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STATUS AND DISTRIBUTION OF THE WHITE-NAPED TIT *PARUS NUCHALIS* IN GUJARAT AND RAJASTHAN[1]

J.K. Tiwari[2]

Key words: White-naped tit, *Parus nuchalis*, status, endangered, Rajasthan, Gujarat, India

This paper describes the status and distribution of the white-naped tit *Parus nuchalis* in Gujarat and Rajasthan. Results are drawn from surveys carried out in seven districts of Rajasthan and three districts of Gujarat. Habitat loss is described in detail. It is established that the grey tit *Parus major* and white-naped tit *P. nuchalis* are not mutually exclusive. Conservation measures to save the habitat of the endangered white-naped tit are also discussed.

Introduction

The white-naped tit *Parus nuchalis*, also known as the white-winged tit or white-winged black tit, is an endemic species in India with a disjunct and restricted range (Ali and Ripley 1987). It is known as *Kabri ramchakli* in Gujarati. Hussain *et al.* (1992), and Tiwari and Rahmani (1996) have described its recent distribution. Nesting and roosting behaviour of the species were studied while I was working with the Bombay Natural History Society on the Grassland Ecology Project, funded by the U.S. Fish & Wildlife Service.

Not much is known about the white-naped tit. It was, therefore, necessary to investigate its present range of distribution to make a conservation action plan. This species has a limited geographic range, due to habitat destruction and invasion of exotic weeds into the thorn forest. The white-naped tit is on the checklist of threatened birds by Collar and Andrew (1988). Its patchy distribution in southern India may be due to fragmentation of scrub forest habitat by human interference. The current status surveys were carried out in Kutch, Palanpur (Banaskantha district), Taranga hills (Mehsana district), Gujarat and seven districts of Rajasthan namely Pali, Jodhpur, Jalore, Sirohi, Ajmer, Jaipur and Nagaur. Short visits were also made to Jaisalmer, Barmer, Dausa and Bharatpur districts, to check the occurrence of the white-naped tit, but these trips were unsuccessful.

Methods

Several birdwatchers in Rajasthan and Gujarat were contacted and information gathered. Literature and maps were collected from various sources. The habitat of the white-naped tit, tropical thorn forests, was scanned with local assistants and birdwatchers.

Results

Gujarat survey

Kutch district: A major part of the Kutch district is still covered with tropical thorn forest, especially near Dhinodhar, Dayapar, Moti-Virani, Piyoni, Matano Madh, Khadir and Gugriana, where white-naped tits were sighted. These tits are common in Kutch district, wherever a healthy thorn forest cover (locally known as Rakhal = Reserve forest) is available. Detailed studies were started from January 1990, around Fulay-Chhari; surveys were conducted in the thorn forests of Kutch (Tiwari and Rahmani 1996). During drought years, the tits were observed in vegetation covered stream beds and irrigated crop fields. This may have exposed the

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endangered tit to pesticides. The white-naped tit is patchily found in almost the entire Kutch, but is common nowhere. It prefers thorn forests with dead and decaying trees for roosting and nesting. The nest is located in holes prepared by the Mahratta woodpecker *Picoides mahrattensis*.

North Gujarat Survey

Banaskantha: Four white-naped tits were seen in the Balaram Reserve Forest and Jethi village near Palanpur city, north Gujarat, in May 1996. Balaram is located in the lush green Aravali hills. Banaskantha district was surveyed from 9 to 11 March, 1996, and a detailed survey was also carried out with S.N. Varu from 19 to 23 May, 1996. North Gujarat is dominated by dry deciduous forest. A 1,625 sq. km reserved forest area exists in Banaskantha district. The major protected areas lie in Baludhara, Jessore Sloth Bear Sanctuary, Balaram Reserve Forest and Ambaji Range Reserve Forest. *Acacia leucophloea* and *Acacia nilotica* trees, which are preferred by white-naped tits, grow along with *Butea monosperma*, *Anogeissus*, *Moringa*, *Terminalia* and *Carrisa*. Chitrasani is the nearest village where two white-naped tits were seen in a mixed flock of grey tit *Parus major*, small minivet *Pericrocotus cinnamomeus*, and white-eye *Zosterops palpebrosa*.

On September 11, 1996, two white-naped tits were observed in an *Acacia nilotica* plantation at Jethi railway station in Banaskantha. Jethi village is about 15 km away from Balaram forest. River Jethi flows through the Balaram forest and supports a healthy, dry deciduous and tropical thorn forest habitat, with some undulating grassland, on the slopes of Aravalli hills. These are ideal habitats for the green munia *Estrilda formosa* and white-naped tit.

The distance between Deesa and Abu Road is 80 km. White-naped tits were spotted in the scattered thorn forest of Beawar (Pali district, Rajasthan), which is 370 kms away from Deesa. Forest fragmentation is evident, as several villages and towns are located here. Deforestation is mainly due to lopping of trees to feed cattle, and clearance of thorn forest for agriculture and residential areas. No white-naped tits were seen in Deesa and its vicinity, but they may occur in these areas in sites like Khera and Auwa where the thorn forest is healthy and relatively less disturbed. Sálim Ali had collected white-naped tits from Deesa on January 10, 1931.

Mehsana district: It occupies 9,027 sq. km in Gujarat. R.M. Simmons had sighted white-naped tits in July 1931, and again in February 1932 (Collar and Andrew 1988), at Taranga hills. S.N.Varu and I had surveyed the Taranga hills on May 21, 1996, but failed to spot any tits. However, the habitat is suitable, and they can occur. The following areas were surveyed on the way to Taranga hills: Netra, Thur hills, Dhori, Hantawada, Mumnavas, Punjpur, Aderan and Vijaran on State Highway No. 56, at Vijaran village. Several stone crushers and stone quarrying were observed; these take a heavy toll of the healthy tropical thorn forest. Taranga lies in the heart of the tropical thorn forest, which is protected by the people for religious reasons, making them a good habitat for wildlife. Two species, yellowthroated sparrow *Petronia xanthocollis* and brahminy myna *Sturnus pagodarum*, which compete with the white-naped tits, were sighted here.

Rajasthan survey

Pali district: This district was surveyed from 15 to 20 March, and again from 4 to 9 October, 1996. White-naped tits were seen at Bar village and in Sendra Reserve Forest on the Pali-Ajmer border, on October 7, 1996.

Important areas for the white-naped tit are near Beawar, Bar, Sendra and Amarpura to Ajmer which bear patches of tropical thorn forest. The *Acacia leucophloea* forest is fragmented by several small to large villages and croplands with

the exotic mesquite or native *Acacia* forest. Several places in these hills, e.g. areas from Haripura to Bar are subjected to gypsum mining.

The forest from Bar (425.8 m) to Sendra (473.08 m) is ideal for white-naped tit. On Oct. 7, 1996 two of them were observed in the Bar village forest, one of which was feeding on a caterpillar. From their calls and yellow gape, they appeared to be one year old juveniles. In the evening, two were seen near Sendra village in a reserve forest. *P. nuchalis* is likely to occur in the following reserve forest areas of Sendra forest range.

	Reserve Forest	Areas
1.	Chang Block	1,161 ha
2.	Borvad	989 ha
3.	Deepavas	411 ha
4.	Kalab Wildlife Range	2,035 ha
5.	Kuneja Wildlife Range	1,373 ha
6.	Majevela	345 ha
7.	Bar	90 ha
8.	Giri	212 ha
9.	Salarmal	187 ha
10.	Suniel	502 ha
11.	Kala Dunger	40 ha
12.	Babra	260 ha
13.	Birathia Modu	102 ha
14.	Kal Lambia Jod*	1,308 ha
15.	Aserlai Jod*	416 ha
16.	Ras	335 ha
17.	Bavra closure	89 ha
18.	Birathia Adi-dang	114 ha

Jod* = Grassland

Prosopis juliflora is a major problem in the forest plantation and in the grassland, which is locally known as beed.

Jalore district: It was surveyed on March 18-19, 1996 and October 3-5, 1996. Two white-naped tits were seen near Sunda-mata hill, which is in good condition, on October 4, 1996.

Ali (1987) described the white-naped and the grey tit as mutually exclusive. Except in the Kutch district, I have seen both these tits in the same patch of forest in many areas. R.M. Adam (1873) had obtained specimens of the grey tit and white-naped tit from the same patch of forest at Maroth in Nagaur district. This was confirmed during the survey of Maroth, where I saw white-naped and grey tits in the same forest patch, at the following places:

1. Balaram and Jethi forest of Banaskantha, North Gujarat.
2. Sunda-mata hill, Jalore.
3. Maroth, Nagaur district.
4. Sambhar, Jaipur district.

Sirohi district: No white-naped tit was seen in the Sirohi district, which is barren and desolate in some parts, and extensively cultivated in others, with a variety of crops. The Aravalli range dissects this district. Recently spread exotics like *Prosopis juliflora*, *Cassia tora*, and *Lantana camara* are causing severe damage to the natural ecosystems of the Aravalli range and plains in Sirohi.

Mount Abu: The Abu hills were scanned for bird life in the first week of October 1996. Grey tits *Parus major* and yellowcheeked tits *P. xanthogenys* were seen in many areas, but white-naped tits were not seen on the Aravalli hills of the Abu range. Perhaps they do not ascend to that altitude (1,371 m) as other Paridae. Yellowcheeked tits were seen, on Adhar Devi areas, on October 2, 1996.

Jodhpur district: No white-naped tits were spotted in this desert district of Rajasthan. There is hardly any dense, tropical thorn forest in this area, except for a few isolated pockets, such as Machia Safari Park, Jodhpur and Har ki Bhakri near Luni. There are scattered *Acacia* trees in agricultural fields, but no *Acacia leucophloea* and *A. nilotica* forests were seen.

Jaipur district: It was surveyed from September 11 to 12 and October 8 to 10, 1996. On October 9, 1996, two white-naped tits were seen in an *Acacia nilotica* and *A. leucophloea* mixed forest at Nasia (Old fort) near Kanota, 11 km away from Jaipur city. A very good plantation of *Acacia* forest can be seen on the hills near Nasia. There is a huge patch of exclusive *Acacia leucophloea* forest beyond Nasia towards Dudu. Good stands of *Acacia* trees

can be seen in the agricultural fields. The hills beyond Kanota are devoid of tree cover. Spear grasses were present on the bare hills. About fifty camel cartloads of wood a day are brought from the villages, to sell in Jaipur. Stone quarrying was going on in the immediate vicinity of the white-naped tit habitat at Kanoda on National Highway No. 11. The pressure on the existing habitat of the white-naped tit is evident. The species was reported from Jaipur district, by Santanu Kumar Singh at Banjar Bhumi near Jaipur in 1993 (*pers. comm.*).

Sambhar Lake City and environs

Sambhar lake: (26° 53' N, 74° 54'-75° 14' E) is the largest inland saline lake in India. The areas around Sambhar lake were surveyed on October 8 and 9, 1996. Jhapok and Guda areas were surveyed for the white-naped, but none were seen. The Devyani areas were surveyed on foot. Impenetrable thickets of *Prosopis juliflora* were seen on the periphery of the lake and its environs.

Nagore district: This district was surveyed on October 9, 1996. Six white-naped tits were seen in three different areas. Two each in Maroth, Panchotia near Nava Town, and Sambhar Saltworks reserve. The Sambhar forest (10 sq. km) is privately maintained by the Sambhar Saltworks authorities. It is about 4 km away from the Nava town of Nagore district. This patch of original *Acacia leucophloea* forest is at present under serious threat, due to tree cutting by the villagers. Two guards are appointed to look after this forest. Cattle grazing and lopping of trees was noticed. If not protected, this small forest tract, which still supports the endangered white-naped tit will soon disappear. R.M. Adam had collected the white-naped tit in Maroth, in 1873.

Ajmer survey

Ajmer is 482 m above msl. The white-naped tit survives in some isolated pockets of the tropical thorn forests in Ajmer district. Apart from the present sight records from the Sendra area, other birdwatchers such as Harkirat Sanga have seen *Parus nuchalis* in at least three places, in Ajmer district (Table 1).

TABLE 1
SIGHT RECORDS OF *PARUS NUCHALIS* FROM AJMER DISTRICT, RAJASTHAN

Date	Place	Nos. sighted	Sighted by
October 7, 1996	Sendra Reserve Forest	2	J. K. Tiwari
October 14, 1996	Kishangarh	2	J. K. Tiwari
April 7, 1994	Ravli Todgarh	1	Harkirat Sanga
May 14, 1995	Nasirabad	2	Harkirat Sanga
January 20, 1996	Near Ramsar, Ajmer	1	Harkirat Sanga

The hills near Ajmer city are extensively planted with *Prosopis juliflora*. Sendra Reserve Forest near Beawar, and the entire hill range in Beawar is home to the white-naped tit. Depending on the habitat, the tits are sparsely distributed in Beawar and Sendra hills. The forested areas near Sendra, Beawar and Kishangarh should be protected by the Forest Department. Deforestation and overgrazing are two major problems in these areas.

CONSERVATION

Observations on the status of the white-naped tit in Kutch, north Gujarat, and Rajasthan indicate that the survival of this endemic species is dependent on the conservation of the tropical thorn forest and protection of dead and decaying *Acacia* trees. The main causes of deforestation in Gujarat and Rajasthan are illegal charcoal making, gathering fuel wood, invasion by exotic plants and many forest bird species like white-bellied minivet (*Pericrocotus erythropygius*) into the tit habitat. Exotics like *Prosopis juliflora* and *Lantana camara* should be eradicated by allowing people to use them as

TABLE 2
SIGHTINGS OF THE WHITE-NAPED TIT IN GUJARAT AND RAJASTHAN

Date	Numbers	Place	Sighted by
May 14, 1994	1	Ravli Todgarh, Ajmer	Harkirat Sanga
April 7, 1994	2	Nasirabad, Ajmer	Harkirat Sanga
January 20, 1996	1	Ramsar, Ajmer	Harkirat Sanga
May 20, 1996	1	Balaram, north Gujarat	J.K.Tiwari & S.N.Varu
September 11, 1996	2	Jethi	J.K.Tiwari
October 4, 1996	2	Sunda-mata, Jalore	J.K.Tiwari
October 7, 1996	2	Bar, Pali district	J.K.Tiwari
October 7, 1996	2	Sendra, Ajmer district	J.K.Tiwari
October 9, 1996	2	Maroth, Nagore district	J.K.Tiwari
October 9, 1996	2	Panchota hill, Nagore district	J.K.Tiwari
October 9, 1996	2	Sambhar Saltworks, Jaipur district	J.K.Tiwari
October 9, 1996	2	Kanota, Nasia, Jaipur	J.K.Tiwari
October 14, 1996	2	Kishangarh, Ajmer district	J.K.Tiwari

fuel wood and for charcoal making under the strict supervision of the Forest Department and with the help of the village headmen.

ACKNOWLEDGEMENTS

I thank the Oriental Bird Club, UK and the Leica Camera Co. for providing funds to conduct this study. The Bombay Natural History Society and the U.S. Fish & Wildlife Service for the opportunity to work in the Bird Migration and Grassland Study projects in Kutch district. I also thank Tim and Carol Inskipp, Asad R. Rahmani, David Ferguson, M.K. Himmatsinhji, S.N. Varu, Aswin Pomal, Rakesh Vyas, Harkirat Sanga, Satish Sharma, Ravi Sanghi, Ganeshan, P.V. Reddy, Anupama and Shiva for their help.

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■ ■ ■

SPECIES STATUS OF *POROPUNTIUS BURTONI* (MUKERJI 1934), (CYPRINIFORMES: CYPRINIDAE) WITH A SYSTEMATIC NOTE ON *POROPUNTIUS CLAVATUS* (MCCLELLAND 1845)[1]

Waikhom Vishwanath and Laishram Kosygin[2]

(*With one plate and two text-figures*)

Key words: *Poropuntius burtoni*, *P. clavatus*, species validity

Poropuntius clavatus burtoni (Mukerji), originally described from Myanmar, has hitherto been considered a junior synonym of *P. clavatus* (McClelland). Based on detailed information from the type specimens and 19 specimens presently collected from the rivers of Ukhrul district of Manipur (Chindwin drainage), India, *P. burtoni* is now established as a valid species. The species differs from *P. clavatus* in having fewer lateral line scales (34-38 vs. 41-42), fewer predorsal scales (12-13 vs.14-15), fewer scale rows between dorsal fin origin and lateral line (6 vs.7), shallower body (26.3-29.4 vs. 29.5-32.9) and shorter dorsal spine length (22.6-28.5 vs. 28.9-31.4). *Poropuntius burtoni* is endemic in the Chindwin-Irrawaddy drainage, whereas *P. clavatus* occurs in the Barak-Brahmaputra drainage.

Introduction

Mukerji (1934) described *Barbus clavatus burtoni* from Mali Hka river, Myanmar (Irrawaddy drainage). He distinguished it from *P. clavatus clavatus* in size, certain body proportions and coloration. Jayaram (1991) put them under *Poropuntius* Smith in the appendix while revising the genus *Puntius* Hamilton. Smith (1931) distinguished *Poropuntius* from *Puntius* in having pores on the snout, lower jaw with horny sheath and a rostral groove. According to Rainboth (1996), the genus *Poropuntius* is characterised by the presence of open pores on the snout and posteriorly serrated last dorsal spine. Jayaram (1981) did not recognise *P. clavatus burtoni* as a species, but considered it to be a Burmese form. Talwar and Jhingran (1991), while describing *Puntius clavatus* (McClelland), did not mention Mukerji's specimen.

In the present study, 19 specimens of *Poropuntius* were collected from Ukhrul district, Manipur (Chindwin drainage). These specimens agree with the description of *P. clavatus burtoni*. However, on detailed examination of the specimens of *P. clavatus clavatus* in the Zoological Survey of India (ZSI) and typical specimens in the Manipur University Museum of Fishes (MUMF), which were collected from the Barak drainage, notable differences were found. In view of the differences in morphology and drainages which the fishes inhabit, *P. burtoni* is considered here to be a valid species.

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Material and methods

Specimens collected in the present study were deposited in MUMF. Type specimens of *Poropuntius burtoni* and other specimens of *P. clavatus* in ZSI and those in the MUMF were examined. Measurements and counts follow Jayaram (1981). Body proportions are expressed as percentages of standard length (SL) and head length (HL). Lateral transverse scales were counted as those between the lateral line and dorsal fin origin (including mid-dorsal scale), and those between the lateral line and pelvic fin origin.

Poropuntius burtoni (Mukerji 1934)
(Plate 1, Fig. 1)

Barbus clavatus burtoni Mukerji, 1934, *J. Bombay nat. Hist. Soc. 37(1)*: 64-67. *Poropuntius clavatus* Jayaram, 1991, *Rec. zool. Surv. India. Occ. Paper 135*: 178.

Local Name: Nung-nga (Manipuri); Rar, Ngapeila (Tangkhul); Aasho (Chakasang).

Material examined: Holotype, ZSLF 11437/1, 107.5 mm SL, Phungin Hka, tributary of Mali Hka River, Myitkyina dist., Upper Myanmar, Coll. R.W. Burton, no date; Paratype, ZSI F1 1462/1, 1 ex., 155.0 mm SL, same data as holotype; 8 exs., MUMF 2061-2068, 84.0-136.0 mm SL, Kongpu river, Bungpa, Ukhrul district, Manipur, Coll. L. Kosygin, 4.vi.1994, 1 ex., MUMF 2005, 95.0 mm SL, Laniye river near Jessami, Manipur-Nagaland state border, 2.ii.1994; 5 exs., MUMF 2028-2032, 93.5-106.5 mm SL, Wanze stream, Khamsom, 20.v.1994; 2 ex., MUMF 2112-2113, 39-40 mm SL, Chal ou river, Thetsi, Manipur-Nagaland state border, 1.vi.1994; 3 exs., MUMF 2195-2197, 27.5-109.0 mm SL, Tizu river at Akash Bridge, near Thetsi 15.viii.1994.

Diagnosis: A species of *Poropuntius* with 34-38 lateral line scales. 6/1/4 lateral transverse scales; 12-13 predorsal scales; body depth 26.3-29.8% of SL; dorsal fin height 22.6-28.5% of SL.

Description: D. iv, 8; P. i, 16; V. i, 8; A. iii, 6; C. 19; L.1. 34-38; L.tr. 6/1/4, Body compressed. Dorsal profile arched from snout tip to dorsal fin origin, then gently sloping down to caudal fin base. Head short, conical. Snout obtusely pointed, longer than eye diameter in adults. Its tip studded with small tubercles. Eye moderately large, not visible from ventral surface. Inter-orbital space convex, slightly greater than eye diameter. Mouth horse-shoe shaped, sub-inferior, cleft of mouth extending nearly to the level of anterior margin of the orbit. Barbels 2 pairs, one each of maxillary and rostral, both

TABLE 1
COMPARISON OF MORPHOLOGICAL CHARACTERS OF *POROPUNTIUS BURTONI* AND *P. CLAVATUS*

	P. burtoni			*P. clavatus*		
ZSI F 11462/1	Holotype ZSI F 1143/1	Paratype ZSI F 11462/1	Present study	ZSI FF 1629	ZSI F 9936/1	MUMF 2265-2267
N		1	19	1	1	3
In % of SL						
Body depth	27.9	28.0	27.9(26.3-29.4)	32.9	31.8	30.1(29.5-30.5)
Head length	23.7	22.3	24.5(22.6-25.7)	22.6	22.6	22.3(22.1-22.6)
Predorsal length	47.4	47.1	49.1(46.7-50.8)	48.5	49.2	48.9(47.8-49.6)
Dorsal fin height	26.0	27.7	24.6(22.6-28.5)	31.4	30.9	29.1(28.9-29.8)
In % of HL						
Head width	52.9	71.0	56.1(52.1-63.3)	58.2	51.8	58.8(55.9-61.3)
Head height at occiput	78.4	75.4	75.8(70.1-81.3)	80.0	75.0	77.8(74.3-80.8)
Snout length	29.8	31.9	32.1(29.8-35.1)	30.9	30.3	30.7(28.9-32.3)
Eye diameter	29.4	28.9	23.9(21.2-26.1)	29.1	30.4	27.5(26.9-28.4)
Interorbital space	33.3	34.8	32.8(28.9-34.9)	32.7	32.1	37.4(35.5-40.0)
Pectoral fin length	86.3	91.3	84.1(78.7-89.3)	96.4	100.0	96.2(95.2-96.9)
Counts						
Pectoral fin rays	i, 16	I, 16	i, 16	i, 15	-	i, 14-15
Lateral line scales	35	34	34-38	42	41	41-42
Lateral transverse scales	6/1/4	6/1/4	6/1/4	7/1/4	7/1/4	7/1/4

W. Vishwanath *et al.*: *Poropuntius* spp. PLATE 1

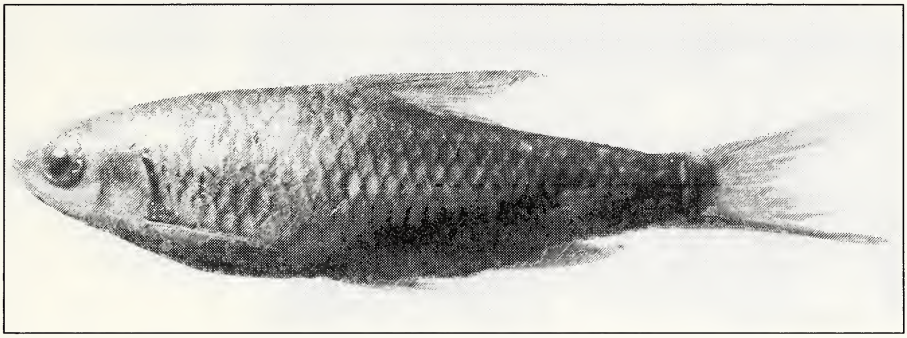

Fig. 1: *Poropuntius burtoni* (Mukerji)

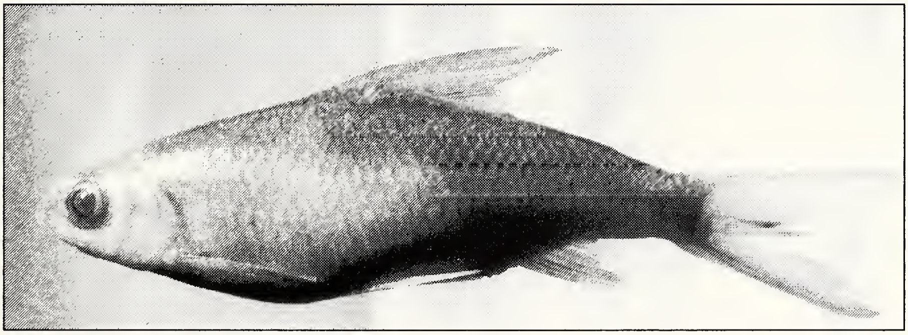

Fig. 2: *Poropuntius clavatus* (McClelland)

as long as eye diameter. Scales large, 12-13 scales in front of dorsal fin origin. Lateral line complete. Dorsal spine strong, osseous, serrated posteriorly, its origin equidistant from snout tip and caudal fin base. Pectoral fins slightly shorter than head length, not reaching pelvic fin origins. Caudal fin forked.

Proportional measurements (in percentage): Body depth 27.9 (26.3-29.4); head length 24.5 (22.6-25.7); predorsal length 49.1 (46.7-50.8); dorsal fin base length 14.9 (14.0-16.0); dorsal fin height 24.6 (22.6-28.5); and caudal fin length 27.4 (25.0-29.8)% of SL. Head width 56.1 (52.1-63.3); head height at occiput 75.8 (70.4-81.3); snout length 32.1 (29.8-35.1); eye diameter 23.9 (21.2-26.1); interorbital space 32.8 (28.9-34.9); pectoral fin length 84.1 (78.7-89.3); and caudal peduncle length 90.2 (85.5-98.0)% of HL. Dorsal fin height 88.8 (82.0-100.0)% of body depth. Caudal peduncle height 52.2 (48.9-58.8) % of its length.

Colour: Body silvery with darker dorsal surface. A few rows of scales are dotted with fine blackish pigment. All the fins light orange. Outer edge of caudal fin tipped with black.

Distribution: INDIA: Manipur (Chindwin basin); Myanmar: Myitkyina District, Irrawaddy drainage.

Remarks: Mukerji (1934) emphasised the size of the fishes while separating the Chindwin form of *Poropuntius* from the Brahmaputra form, i.e. *P. clavatus clavatus* of the genus. He reported that the maximum size of the Chindwin form was 172 mm SL and that of Brahmaputra, only 120 mm. Sen (1985) mentioned that the largest specimen recorded for the latter was 7 inches (=178 mm), while the specimens collected from Barak river (MUMF) measure about 195 mm in SL.

Thus, the comparative sizes cannot be the basis for separating the two forms. *P. burtoni* is distinguished from *P. clavatus* in having fewer lateral line scales (34-38 vs. 41-42); fewer predorsal scales (12-13 vs. 14-15); fewer scale rows between dorsal origin and lateral line (6 vs. 7) shallower body (26.3-29.4 vs. 29.5- 32.9) and shorter dorsal fin height (22.6-28.5 vs. 28.9-31.4). Thus, *P. burtoni* is given specific status in the present study. Figs 1 and 2 compare the body depths and spine lengths of the two species.

Poropuntius clavatus (McClelland 1845)
(Plate 1, Fig. 2)

Barbus clavatus McClelland, 1845. *Calcutta J. nat. Hist.*, 280, pl. 21 (type locality: Sikkim mountains on the northern frontier of Bengal).

Puntius clavatus: Menon, 1974, *Inland Fisheries Soc. of India,* Spl. Pub. 1:38.

Poropuntius clavatus: Jayaram, 1991, *Rec. zool. Surv. India*, 135: 172.

Local name: Nung-nga (Manipuri).

Material examined: 1 ex., ZSIFF 1629, 121.5 mm SL, Jatinda river, Assam, India, Coll. S.C. De, no date; 1 ex., ZSI F 9936/1, 124.0 mm SL, Karong, Naga Hills, Manipur, Coll. S.L. Hora, no date; 3 ex., MUMF 2265-2267, 168.8-195.5 mm SL, Barak river, Sekjang Tuifai, Manipur, India, Coll. Ch. Bashuda, 14.ii.1997.

Diagnosis: A species of *Poropuntius* with 41-42 lateral line scales; 7/1/4 lateral transverse scales; 14-15 predorsal scales; body depth 29.5-32.9% of SL; dorsal fin height 28.9-31.4 % SL.

Distribution: INDIA: Assam, Manipur (Brahmaputra basin), Sikkim, West Bengal; Bangladesh.

Remarks: McClelland (1845) described *P. clavatus* from Sikkim, India. Menon (1974) considered *P. burtoni* a junior synonym of *clavatus* and extended the distribution of the fish to Myanmar. However, from the present study it is clear that they are two distinct species. Thus, *P. clavatus* is distributed only in the north-eastern part of India and Bangladesh.

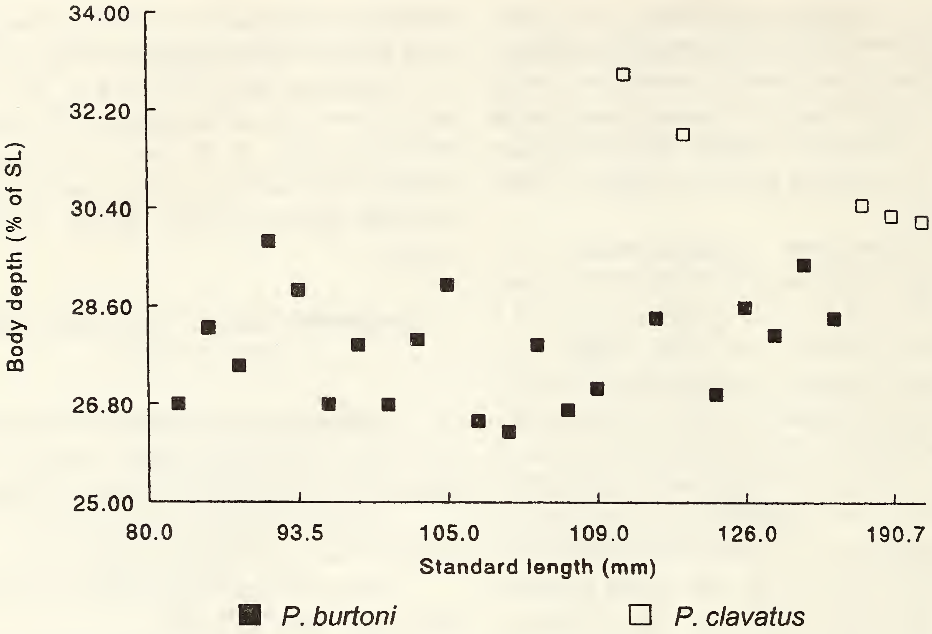

Fig. 1: Relationship between body depth and standard length of *P. burtoni* and *P. clavatus*

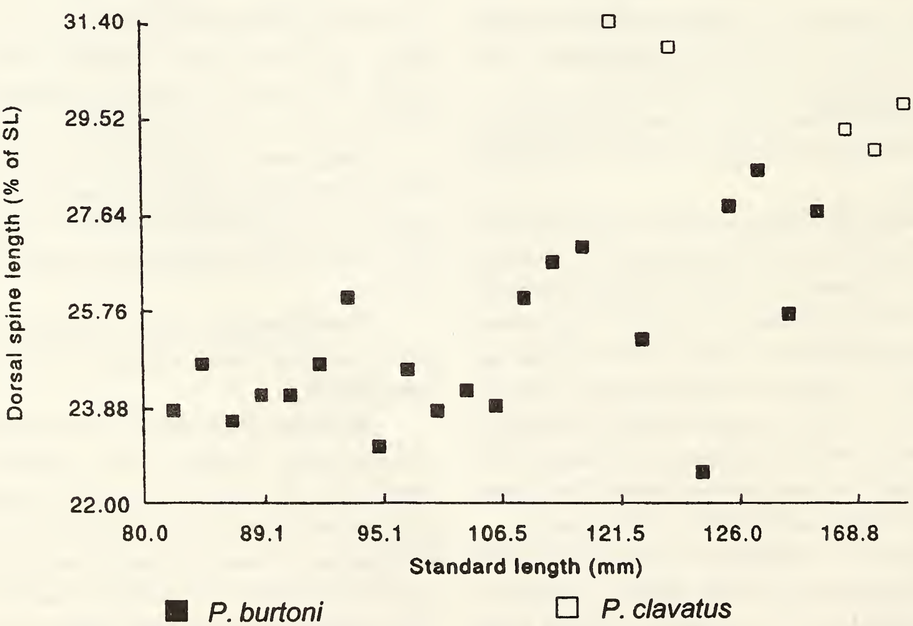

Fig. 2: Relationship between dorsal spine length and standard length of *P. burtoni* and *P. clavatus*

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■ ■ ■

FOOD SPECTRUM OF THE COMMON INDIAN TOAD *BUFO MELANOSTICTUS* SCHNEIDER[1]

MERCY MATHEW AND M.I. ANDREWS[2]

(*With one text-figure*)

Key words: *Bufo melanostictus*, food, feeding habits

The food and feeding habits of *Bufo melanostictus* in the Kuttanad region of Kerala were studied. Arthropods formed a major food item while insects were the most favoured food of the species. The present study reaffirms that the toad is a useful anuran for controlling pests.

INTRODUCTION

The stomach contents of many anuran species have been examined to determine their role in an ecosystem. Though the food of several anuran species inhabiting temperate regions has been studied extensively (Drake 1914, Berry and Bullock 1962, Berry 1970, Blackith and Speight 1974, Strussman *et al.* 1984, Barrentine 1991, Evans and Lampo 1996, De Bruyn *et al.* 1996), the food and feeding habits of only a few tropical species have been investigated (Wadekar 1963, Isaac and Rege 1975, Nigam 1979, Mohanty-Hejmadi *et al.* 1979, Battish and Sandhu 1988, George and Andrews 1995).

In the Indian subcontinent, the food and feeding habits of toads were studied by some workers (Rangaswami and Channabasavanna 1973, Battish *et al.* 1989, Sreelatha *et al.* 1990). Except for the latter, no detailed work has been done on the food spectrum of *Bufo melanostictus* in Kerala. The present study was, therefore, undertaken to determine the food of *B. melanostictus* in the Kuttanad region of Kerala and its role as a biocontrol agent.

MATERIAL AND METHODS

Stomach content analysis of *B. melanostictus* was carried out from January 1991 to December 1992. A total of 213 toads (80 males and 133 females) were examined. Adult toads were collected at night from paddy fields and habitats in Kuttanad, a natural wetland of Kerala. They were killed immediately and preserved in 10% formalin. The toads were weighed and sexed in the laboratory. The stomach was excised from the toad and weighed. The weight of its contents were recorded separately. The contents were examined under a binocular dissecting microscope, sorted and preserved in 70% alcohol. Food items were identified and the number of individuals of each type were recorded. The correlation between the body weight and weight of gut contents was statistically analysed.

RESULTS

The distribution of stomach contents of *B. melanostictus* (expressed as a percentage of total body weight) with respect to sex and month is shown in Table 1. Female toads were found to consume more food than males except in September, November and December. The females collected in January, May and June were observed to have a higher percentage weight of stomach contents. Table 2 lists the classified food items of *B. melanostictus* and their economic importance. It is evident from the data obtained that the food of *B. melanostictus* consisted of invertebrates of 15 orders (Table 3). The toad mainly fed on arthropods. No vertebrate prey was found. Stomachs of 14 specimens examined were empty. Ant species dominated the diet (56.36%). Termites, though numerically abundant

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TABLE 1
STOMACH CONTENTS OF *BUFO MELANOSTICTUS* EXPRESSED AS PERCENT OF TOTAL BODY WEIGHT WITH RESPECT TO SEX AND MONTH

Month	Sex	
	Male (%)	Female (%)
January	2.48	6.34
February	3.35	3.81
March	2.3	3.22
April	2.78	3.2
May	6.2	7.62
June	2.63	5.49
July	1.58	2.69
August	1.41	1.77
September	3.65	1.8
October	1.81	3.75
November	2.75	2.29
December	3.6	2.84

(26.11%), were preferred by fewer toads. Coleopterans formed the next largest group (9.62%) (Fig. 1). Orthoptera, Hemiptera, Heteroptera, Diptera, Millipedes, Araneida, molluscs and earthworms were also identified. A substantial amount of plant material was present in several stomachs. Miscellaneous items like sand, gravel, stone, hair, seed and flower bud were also recorded.

It is evident from the data that this toad fed on a variety of insects belonging to 15 families of the order Coleoptera. Phytophagous insect pests like *Anoplogenius* sp., *Gonocephalum* sp., *Diocalandra fruminti*, *Rhynchaenus mangifera*, *Sipalus* sp., *Sternochaetus mangifera*, *Sitophilus oryzae*, *Onthophagus* sp., *Anomala chlorocarpa*, *Autoserica insanabilis*, *Anomala* sp. and *Adoretus* sp. were recovered from the gut of *B. melanostictus*. It also fed on root pests like *Cylas* sp., *Heteronychus lioderes*, *Anomala dussumeiri* and *Melanotus hirticornis*, pests of tuber crops like *Lema* sp. and pests of stored grains like *Aliphitobius piceus* and *Rhizopertha dominica*. Predaceous beetles like *Cicindella* sp., *Termitodiscus* sp. and *Luciola* sp., and other

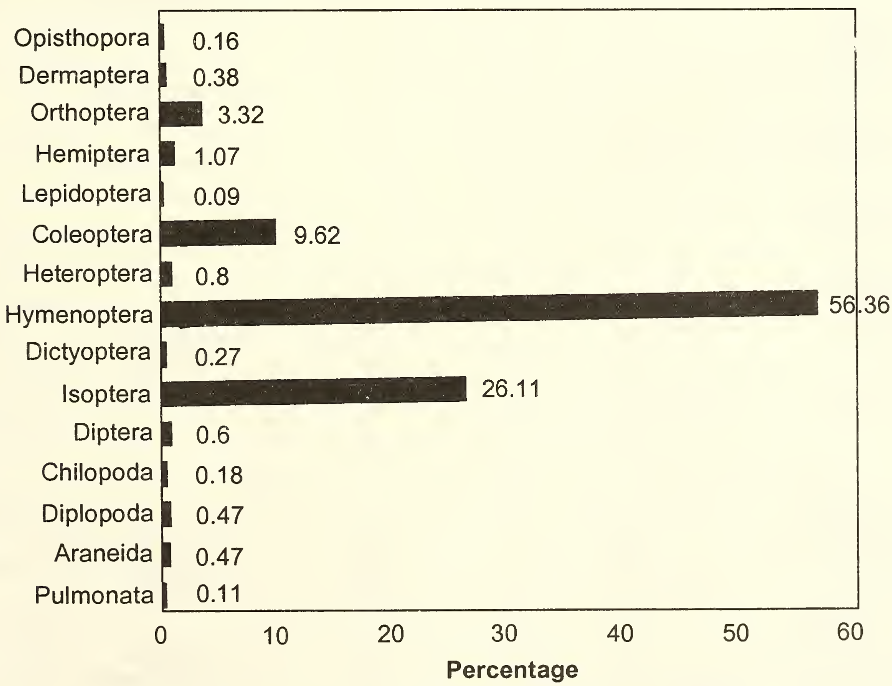

Fig. 1: Annual consumption of food items by *B. melanostictus*

TABLE 2
FOOD SPECTRUM OF *BUFO MELANOSTICTUS*

Classified food item	Number of individuals collected	Number of stomachs examined	Economic importance
Annelida			
Class: Oligochaeta			
Order: Opisthopora			
Family: Megascolecidae			
Megascolex sp.	9	7	
Arthropoda			
Class: Insecta			
Order: Orthoptera			
Family: Tridactylidae	2	2	
Family: Acrididae			
Oxya hyla hyla	35	21	Very harmful to paddy
Oxya chinensis	33	30	Pest of rice and vegetables
Oxya sp.	10	7	Harmful to paddy
Hieroglyphus banian	35	31	Pest of paddy
Family: Gryllidae			
Gymnogryllus sp.	19	11	Omnivorous
Gryllus sp.	25	20	Omnivorous
Family: Gryllotalpidae			
Gryllotalpa sp.	25	18	Household pest, injurious to cultivated plants
Order: Hemiptera			
Family: Cercidae			
Leptocorisa acuta	22	10	Pest of paddy
Family: Delphacidae			
Nilaparvata lugens	30	7	Pest of paddy
Family: Scutelleridae			
Chrysocoris stollii	7	5	Pest of garden plants
Order: Coleoptera			
Family Carabidae			
Anoplogenius sp.	12	7	Paddy pest
Scarites sp.	18	13	Crop pest
Siggona sp.	5	4	Crop pest
Gnathophorus sp.	2	2	
Civina sp.	2	2	
Kareya sp.	2	2	
Family: Tenebrionidae			
Aliphitobius piceus	49	10	Pest of stored grains
Gonocephalum strigatum	36	15	Paddy pest
Gonocephalum sp.	133	38	Paddy pest
Family: Curculionidae			
Rhynchaenus mangiferae	7	5	Mango pest
Diocalandra fruminti	29	12	Foliage feeding
Myllocerus pustulatus	13	5	Pest of vegetable and other plants

TABLE 2 (*contd*)
FOOD SPECTRUM OF *BUFO MELANOSTICTUS*

Classified food item	Number of individuals collected	Number of stomachs examined	Economic importance
Sipalus sp.	3	3	Crop pest
Xanthoprochilus sp.	5	5	
Sternochetus mangifera	3	3	Nut weevil (mango pest)
Sitophilus oryzae	17	10	Stored product pest
Family: Apionidae			
Cylas sp.	4	4	Grubs, pest of tuber crops
Family: Scarabidae			
Hybosorus orientalis	10	6	
Heteronychus lioderes	13	7	General root pest
Popillia sp.	17	5	
Onthophagus sp.	22	9	Crop pest
Serica sp.	3	3	Crop pest
Heliocopris bucephalus	5	3	
Anomala dussumeiri	12	5	Larval forms damage roots of paddy and cereals
Anomala chlorocarpa	12	4	Pest of cashew
Autoserica insanabilis	3	3	Pest of cashew
Family: Elateridae			
Melanotus hirticornis	2	2	Larva feed on roots of plants and pest of stored food grains
Heteroderis sp.	2	2	
Attica sp.	1	1	
Family: Chrysomelidae			
Lema sp.	6	6	Pest of tuber crops
Family: Bostrichidae			
Rhizopertha dominica	18	11	Serious pest of stored grains
Family: Cerambycidae	7	7	
Family: Passalidae			
Ophrigonius sp.	15	7	
Family: Cicindellidae			
Cicindella sp.	13	8	Predator
Family: Staphylinidae			
Termitodiscus sp.	10	5	Predator
Family: Rutelidae			
Anomala sp.	4	4	
Adoretus sp.	7	5	Pest of garden plants
Family: Dasicillidae	3	3	
Family: Lampyridae			
Luciola sp.	3	3	Predator
Order: Heteroptera			
Family: Pentatomidae			
Scotinophora sp.	37	20	Pest of rice
Scotinophora bispinosa	7	7	Paddy pest

TABLE 2 (*contd*)
FOOD SPECTRUM OF *BUFO MELANOSTICTUS*

Classified food item	Number of individuals collected	Number of stomachs examined	Economic importance
Order: Hymenoptera			
Family: Formicidae			
Pheidologeton affinis	44	11	
Pheidologeton sp.	45	20	Household pest
Oecophylla smaragdina	81	17	Household pest
Camponotus compressus	1319	50	Nuisance to trees
Camponotus sp.	1324	70	Household pest
Diacamma sculptum	30	10	
Diacamma vagans	9	7	nuisance to trees
Megachila sp.	225	70	
Solenopsis geminata	13	7	Pest of vegetable seedlings
Family: Mutillidae			
Mutilla sp.	4	4	
Order: Dermaptera			
Family: Forficulidae			
Forficula sp.	19	18	
Order: Lepidoptera			
Caterpillar	5	5	
Order: Dictyoptera			
Family: Blattidae			
Periplaneta americana	9	9	Household pest
Family: Blatellidae			
Blatella germanica	6	6	Household pest
Order: Isoptera			
Termite	1433	14	Household pest
Order: Diptera			
Family: Culicidae			
Anopheles sp.	24	18	Household pest - vector
Family: Muscidae			
Musca sp.	10	10	Household pest - vector
Class: Myriapoda			
Order: Chilopoda			
Family: Scolopendridae			
Scolopendra sp.	10	10	
Order: Diplopoda			
Family: Julidae	26	23	
Class: Arachnida			
Order: Araneida			
Family: Lycosidae			
Paradossa songossa	12	11	Biological control agent
Lycosa sp.	14	13	Biological control agent
Mollusca			
Cryptozona sp.	6	6	

coleopterans like *Scarites* sp., *Siggona* sp., *Civina* sp., *Kareya* sp. *Gonocephalum* sp., *Gonocephalum strigatum, Myllocerus pustulatus*, *Xanthoprochilus* sp., *Hybosorus orientalis*, *Serica* sp., *Heteroderis* sp., *Attica* sp., *Ophrigonius* sp. were also obtained from the gut content (Table 2).

Among the heteropterans, serious rice pests like *Scotinophora bispinosa* and another unidentified species of the same genus were found in the food contents of *B. melanostictus* (Table 2). Hymenopterans were well represented in the food contents. Among them, *Pheidologeton affinis*, *Oecophylla smaragdina* (household pest), *Camponotus compressus*, *Camponotus* sp., *Diacamma vagans*, *Megachila* sp., (tree pests) and *Solenopsis geminata* (vegetable seedling pest) constituted the major portion. A few ant parasites, genus *Mutilla* (Mutillidae) were also found.

The data obtained was statistically analysed and a strong positive correlation was found between body weight and gut weight, and between body weight and gut content weight. (Table 4).

Discussion

The present study reveals that *B. melanostictus* feeds on a wide range of organisms. The food of this toad consists of invertebrates; no vertebrate prey were found. The toad's selection of these organisms is a chance factor. The representation of several orders and families of invertebrates from diverse habits like terrestrial, aquatic and agro-ecosystems showed the toad's affinity to them. Feeding is evidently unselective in *B. melanostictus*, as animals with noxious protective and offensive mechanisms like centipedes, millipedes and spiders are frequently taken. Further, this toad is primarily insectivorous. No cannibalism was observed. Toads, however, are reported to be carnivorous and cannibalistic by Noble (1918) and Sreelatha *et al.* (1990).

The food consumption of the toad is high in May-June and low in July-August. The high food consumption in May-June is because of greater reproductive activity in the monsoon season. The decline in the feeding rate in July-August can be attributed to the low availability of terrestrial insects during the monsoon.

The food spectrum obtained in the present study indicates that arthropods form the bulk of the diet of *B. melanostictus*. Among them, insects appear to be the most favoured. In the present study, Hymenopteran ants of family Formicidae were dominant in the diet of the toad, substantiating the works of Weber (1938) in *B. marinus*, Forge and Barbault (1980) in *B. pentoni*, Battish *et al.* (1989) in *B. stomaticus*, and Evans and Lampo (1996) in *B. marinus*.

It has been reported that, in terms of biomass, coleopterans were predominant in the food of *B. melanostictus* (Berry and Bullock 1962) and *B. stomaticus* (Battish *et al.* 1989). The consumption of large numbers of Coleoptera by *Rana tigerina* (=*Hoplobatrachus tigrinus*) during the pre-breeding period has been noted by Khan (1973). As is clear from the present study, *B. melanostictus* mainly feeds on terrestrial insects. Similar observation was made by Berry and Bullock (1962). This can be correlated with the prey availability in the toad's habitat.

The present study shows that the seasonal variation in the food of *B. melanostictus* may be due to a seasonal change in the availability of prey. Similar observations were made by Brooks (1959), Berry (1965), Khan (1973) and Battish *et al.* (1989). According to Jenson and Klimstra (1966), Hedeen (1970) and Nigam (1979), anurans are opportunistic feeders. The more frequent occurrence of toads in vegetable gardens and orchards is due to the easy availability of prey. A correlation was also found between the abundance of toads and the ground

TABLE 3

PERCENTAGE OF FOOD ITEMS RECOVERED FROM STOMACHS OF *BUFO MELANOSTICTUS* FROM JANUARY 1991 TO DECEMBER 1992

Animal Groups	Months											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov .	Dec.
Opisthopora	0.41				0.08	0.19	1.71	1.98		0.18		
Dermaptera			0.91	2.22	0.08	0.39		3.96	0.09	0.18	0.81	1.25
Orthoptera	7.88	5.58	3.35	21.48	1.60	2.90	13.68	11.88	0.96	1.56	2.42	10.0
Hemiptera		5.58	4.27		0.15		0.85	0.99	1.22	1.28	0.81	
Lepidoptera		0.47	0.61		0.08							0.63
Coleoptera	13.69	22.79	10.98	49.63	8.02	14.12	49.57	15.84	1.04	2.02	19.35	20.63
Heteroptera		16.74	0.30			0.58	2.56	0.99				
Hymenoptera	65.98	37.21	65.55	21.48	12.76	40.81	18.80	5.94	94.70	92.12	33.06	43.13
Dictyoptera	0.83			0.74	0.23		0.85				3.23	2. 50
Isoptera	8.30	8.84	11.89		75.17	40.23		47.52	1.74	2.11	35.48	17.50
Diptera	1.66	0.47	0.61	3.7 0	0.92	0.19	0.85	2.97	0.09	0.09	0.81	0. 63
Chilopoda						0.19	4.27			0.18	0.81	0.63
Diplopoda	0.41	0.47	0.30		0.08		5.98	7.92	0.17		2.42	1.25
Araneida	0.41	1.86	0.91	0.74	0.76	0.39	0.85			0.27		0.63
Pulmonata	0.41		0.30		0.08						0.81	1.25

TABLE 4
CORRELATION METRICES OF FEEDING ACTIVITY OF *BUFO MELANOSTICTUS*

Correlation between	Females	Males
Body wt. vs Gut wt.	0.85**	0.68**
Body wt. vs Gut content wt.	0.61**	0.45**
Gut wt. vs Gut content wt.	0.92**	0.68**

** Significant for $p < 0.01$

fauna. Strussmann *et al.* (1984) noted that although *B. marinus* ate most prey items in proportion to their abundance, positive selection was shown for ants and termites. In the present study, the dietary differences found between habitats may simply reflect the availability of prey.

The stones, leaves and other debris present in the gut of *B. melanostictus* might have been ingested incidentally with the prey. The presence of stones and vegetable matter in the gut of anurans has been reported earlier (Berry and Bullock 1962, Berry 1965, Battish *et al.* 1989, Sreelatha *et al.* 1990, George and Andrews 1995, Evans and Lampo 1996). Possibly, the stones and plant matter help to crush food items such as beetle carapaces in the stomach. Other objects like grain, seed and flower bud are probably mistaken for food.

The present study reaffirms that *B. melanostictus* is a natural predator of various insect pests, especially some serious crop pests. Though toads are known opportunistic feeders, their feeding on several phytophagous insect pests indicates their usefulness as biological control agents. This has been stressed by several earlier workers (Gadow 1901, Kadam and Patel 1960, Stiles *et al.* 1969, Fellow 1969). It has been reported that *R. tigerina* (=*Hoplobatrachus tigrinus*) (Abdulali 1985), *B. stomaticus* (Battish *et al.* 1989), *B. melanostictus* (Sreelatha *et al.* 1990), *R. limnocharis* (=*Limnonectes limnocharis*) (Sally *et al.* 1992) and *R. hexadactyla* (=*Euphlyctis hexadactylus*) (George and Andrews, 1995) are significant in controlling agricultural pests. *B. melanostictus* feeds on insects, ants and spiders, some of which are beneficial. This toad may be considered useful for the control of pests and other harmful insects, playing an important role in the economy of nature.

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TAXONOMIC POSITION OF THE INDIAN SPECIES OF GRASS FEEDING DELTOCEPHALINE LEAFHOPPERS ASSIGNED TO THE GENUS *ALLOPHLEPS* (HEMIPTERA : CICADELLIDAE)[1]

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(*With five text-figures*)

Key words: Taxonomic position, Deltocephaline leafhoppers, *Deltocephalus*

The genus *Allophleps* is redefined based on the specimen from Africa. The Indian species assigned to this genus are transferred to the genus *Deltocephalus* which is redefined along with a key to the Indian species. The following new combinations are proposed: *Deltocephalus indicus* (Pruthi) and *D. menoni* (Rao and Ramakrishnan). *Allophleps delhiensis* Rao and Ramakrishnan is treated as a major synonym of *D. indicus*.

Introduction

Bergroth (1920) described the genus *Allophleps* for his new species *Allophleps inspersa* from Kenya. Pruthi (1936) described *Allophleps indicus* from Lyallpur (Pakistan), thus recording the genus from the Indian subcontinent. Rao and Ramakrishnan (1990) provided the diagnosis of the genus based on the Indian species and added two new species, namely *A. delhiensis* and *A. menoni* from New Delhi. They also provided a key to the three known species from the Indian subcontinent.

During our studies of the Indian *Deltocephalus*, we discovered a number of specimens assignable to the three known species of *Allophleps*, but we realised that the species from the Subcontinent were misplaced in *Allophleps*. An examination of the authentically identified specimen of *A. inspersa* confirmed our doubt and we report here the results of our studies.

The abbreviations used for the depositories are as follows: BMNH – The Natural History Museum, London; NPC - National Pusa Collection, Indian Agricultural Research Institute, New Delhi; UAS - Department of Entomology, University of Agricultural Sciences, Bangalore and ZSI - Zoological Survey of India, Calcutta.

Allophleps Bergroth

Allophleps Bergroth 1920: 27. Type species: *Allophleps inspersa* Bergroth, by original designation.

Macropterous leafhoppers measuring more than 6 mm. Head slightly narrower than pronotum, longer medially than next to eyes. Vertex polished. Face slightly wider than long, shagreened, antennal ledge well developed, impinging slightly on clypeus, ocelli close to eyes. Pronotum with carinate lateral margins, transversely wrinkled, sparsely punctate, polished. Scutellum polished, area beyond impressed line transversely rugulose. Fore wing without accessory cells, outer ante-apical cell smallest, apically narrowed. Hind femoral spinulation 2+2+1.

Male pygophore with well developed anterior apodeme, a group of macrosetae on dorsal margin at the base of origin of anal segments; lobe narrowed with sclerotized bar along dorsal area, apex sclerotized, pigmented. Valve broad with a median angular projection on caudal margin. Subgenital plate triangular with outer marginal row of stout setae. Style with small preapical lobe, apophysis well developed, apex broadened with prominent crenulations.

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Connective Y-shaped, arms well separated, stem distally bilobed. Aedeagus articulated with connective, shaft curved tubular, apex flared with large gonopore, ventral part produced into a bilobed process beyond gonopore, dorsal apodeme well developed.

Remarks: Oman *et al.* (1990) placed this genus under the tribe Fieberiellini. However, because of the well developed apophysis of style and Y-shaped connective with divergent arms, we place this genus in the tribe Euscelini.

Allophleps inspersa Bergroth, 1920
(Figs 1-5)

Allophleps inspersa Bergroth, 1920: 28.

Material examined: Tanganyika: 1 ♂, Lake Nyassa, 1,600 ft (488 m), 34° 00' E, 9° 30' S, 28.viii.1959, Cambridge E. Africa Exped. B.M. 1960-50, *Allophleps inspersa* Bergr. Det. M.D. Webb, comp. with type (BMNH).

Indian species of *Allophleps*

The male genitalia and wing venation of the three species from the Indian subcontinent assigned to *Allophleps* are well illustrated by Pruthi (1936) and Rao and Ramakrishnan (1990), hence they are not illustrated here. A study of these species suggests that they belong to the genus *Deltocephalus* of the tribe Deltocephalini. The genus *Deltocephalus* is redefined here (Kramer 1971).

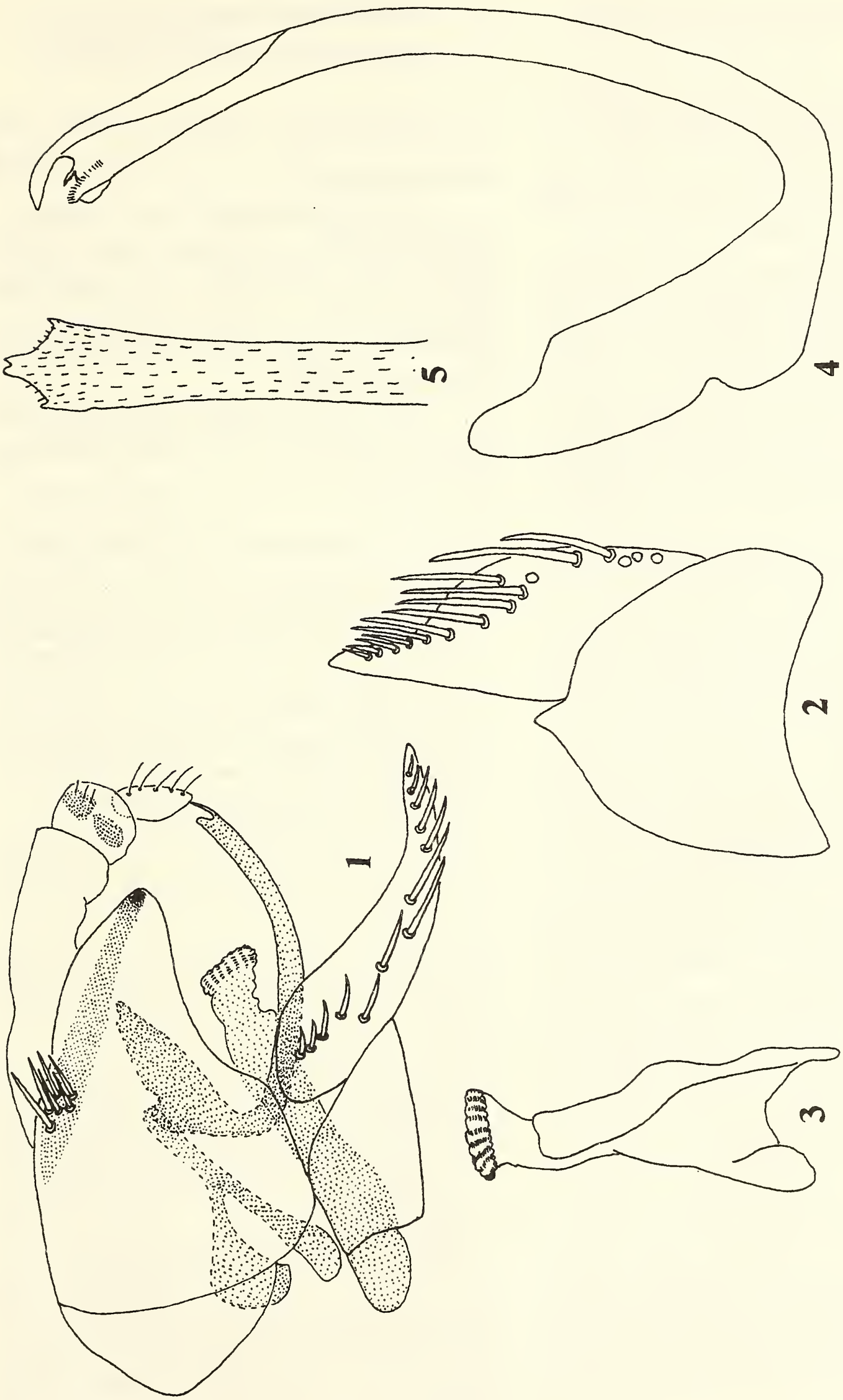
Deltocephalus Burmeister

Jassus subgenus *Deltocephalus* Burmeister, 1938: 15. Type species: *Cicada pulicaris* Fallén, type by subsequent designation by Kirschbaum, 1858: 356.

Moderately small, comparatively robust leafhoppers measuring 2.2-4.1 mm. Head including eyes as wide as or slightly wider than pronotum, crown produced beyond eyes and bluntly angular at apex, anterior margin of crown broadly and smoothly rounded to face, crown in lateral view usually distinctly inflated or convex. Ocelli marginal, small, and rather remote from eyes. Clypeal suture often obscure; clypellus quadrate with sides parallel. Fore wings long and extending well beyond abdomen or shortened and exposing apex of abdomen; in forms with shortened fore wings, the apical cells and each appendix are much reduced and at times rarely open basally, central cell divided or not, outer cell often reduced and sometimes absent.

Male pygophore simple, without prominent processes, but with macrosetae, anal collar with or without a simple process, subgenital plate triangular or rarely hemispherical, not produced into a membranous appendage. Valve and subgenital plates separate. Style with slender and more or less finger-like apophysis. Connective linear and fused with aedeagus; aedeagal shaft broadest in basal half and tapering distally to a slender upturned apex, extreme apex simple or slightly elaborated with small projections or minute teeth on distal margin below apex.

Remarks: The genus shares the characters of fused connective and aedeagus with *Matsumuratettix* Metcalf and *Miradeltaphus* Dash and Viraktamath among the Indian genera. It differs from *Matsumuratettix* in the shape of the aedeagus and from *Miradeltaphus* in having valves and subgenital plates separate. Dash and Viraktamath (1995) treated the genus *Recilia* Edwards as a subgenus of *Deltocephalus* and stated that most of the Indian species assigned to the genus *Deltocephalus* belong to this subgenus. However, the male genitalia of the following species are not known: *brunnescens* Distant, *butleri* Distant, *campbelli* Distant, *coloratus* Distant, *deletus* Baker and *pulvisculus* Distant and hence, they have not been assigned to any subgenus. The Indian species assigned to *Allophleps* agree with the characters of the genus *Deltocephalus* and hence, the following new combinations and a synonym are proposed:



Figs 1-5: *Allophleps inspersa* Bergroth, 1. Male genitalia, lateral view; 2. Valve and subgenital plate, ventral view; 3. Style; 4. Aedeagus, lateral view; 5. Apex of aedeagal shaft, ventral view.

Deltocephalus indicus (Pruthi 1936), Comb. nov.

Allophleps indicus Pruthi, 1936: 120. Holotype ♀, Pakistan [ZSI, examined].

Allophleps delhiensis Rao and Ramakrishnan, 1990: 111. Holotype ♂, India [NPC, examined]. Syn. nov.

Material examined: PAKISTAN: Holotype ♀, 5411/H7, Lyallpur, Punjab (at light) 10.x.1929, A. Rahman, *Allophleps indicus* sp. nov., H.S. Pruthi, det. Paratype ♂, 5700/H7, data as in holotype (ZSI). INDIA: Holotype ♂, Delhi, 30.iv.1965, inside lamp dome, M.G.R. Menon *Allophleps delhiensis* sp. nov. Paratypes: 5 ♂ data as for holotype of *A. delhiensis* (NPC).

Remarks: Female illustrated by Pruthi (1936: Plate IX, Fig. 3) clearly shows the reticulate venation on both clavus and corium of fore wing. However, the wing venation shown in the text-figure 132a (p. 120) does not show this. Apparently this wing was taken from a different specimen. In the type series, the holotype female (5411/H7) and the paratype male (5700/H7) and one female from the type locality (5697/H7) show reticulate venation, whereas another female from the type locality (5698/H7) does not show reticulate venation and also does not belong to this species. The principal difference suggested in the key by Rao and Ramakrishnan (1990) between *indicus* and *delhiensis* was reticulate venation though they mentioned slight differences in the structure of subgenital plates and apophysis of style. The latter varies with the orientation of the style while making the diagram. The structure attributed to subgenital plates in Fig. 132b by Pruthi (1936: 12) is probably part of the pygophore lobes. There is no difference in the structure of connective and aedeagus and therefore, *delhiensis* is here treated as a junior synonym of *indicus*.

Deltocephalus menoni (Rao and Ramakrishnan, 1990), Comb. nov.

Allophleps menoni Rao and Ramakrishnan, 1990: 113. Holotype ♂, India [NPC, examined].

Material examined: INDIA: Holotype ♂, Delhi, 30.iv.1965, inside lamp dome, M.G.R. Menon (NPC). Paratypes: 5 ♂ data as for holotype (NPC). Other material: INDIA: Karnataka: 1♂, Dharwar, 22.x.1969, C.A. Viraktamath (UAS).

The following key will help in the identification of the known Indian species of *Deltocephalus*.[4]

KEY TO THE INDIAN SPECIES OF *Deltocephalus*

1. Fore wings with many accessory cross veins both on clavus and corium or outer ante-apical cell narrowed and pointed at apex or divided into two or more cells 2
— Fore wing without accessory cross veins, outer ante-apical cell neither narrowed and pointed at apex nor divided into two or more cells 4
2. Aedeagal shaft compressed and bifurcate 3
— Aedeagal shaft tubular and not bifurcate .... *pruthii* Metcalf
3. Aedeagal shaft with a short tooth-like process near gonopore .... *menoni* (Rao and Ramakrishnan)
— Aedeagal shaft with longer caudally directed process near gonopore .... *indicus* (Pruthi)
4. Head with red markings 5
— Head without red markings 6
5. Vertex of head with four red spots, pronotum with red stripes .... *deletus* Baker
— Vertex of head with a pair of longitudinal red stripes between eyes, pronotum with black longitudinal lines .... *coloratus* Distant
6. Apex of hind tibia with a black patch; head, thorax and fore wings with brown spots .... *pulvisculus* Distant

[4]Dash and Viraktamath (1998) described 24 new species of *Deltocephalus* (that are not included in this key) and also gave a key to all the known species of *Deltocephalus* from India and Nepal.

— Apex of hind tibia not marked as above, other characters not as above 7
7. Predominantly black or chocolate brown species 8
— Ochraceous or stramineous with fuscous or black spots 9
8. Colour black with yellow transverse bands on face, crown, pronotum and scutellum .... *banda* (Kramer).
— Anterior half of vertex black with three white spots, pronotum scutellum and fore wings chocolate brown .... *prabha* (Pruthi)
9. Fore wing with zigzag reddish-brown marking .... *dorsalis* Motschulsky
10. Head and thorax orange red or orange yellow with or without a black spot on disc of vertex .... *porticus* Melichar
— Head and thorax ochraceous or fuscous with or without black markings 11
11. Vertex with prominent large black markings or with marginal black band surrounding white spots 12
— Vertex with either fuscous or small black spots or without any markings 14
12. Anterior margin of head with a black stripe spotted with white; subgenital plates as wide as or wider than inner margin, apically strongly rounded .... *distinctus* Motschulsky
— Disc of vertex with one or more large black spots; subgenital plates triangular 13
13. Vertex with one apical large black spot .... *butleri* Distant
— Vertex with three black spots .... *maculatus* (Pruthi)
14. Vertex with four small anterior fuscous spots, with a longitudinal fuscous stripe on either side of median line and a transverse series of fuscous spots on pronotum, fore and mid-tibiae annulated with brown .... *brunnescens* Distant.
— Not with above combination of characters ... 15
15. Vertex with anterior marginal spots, anterior aspect of pronotum obscurely tuberculate, fore wing pale ochraceous with white spots .... *campbelli* Distant
— Not with above combination of characters ... 16
16. Aedeagal shaft short, stout at apical 0.33, dorsally upturned with ventral apical extension 0.66 as long as shaft, dorso-apical angle spine-like .... *indicus* (Rao)
— Aedeagal shaft not as above 17
17. Male subgenital plate strongly narrowed caudally, lateral margin straight in distal 0.66, aedeagus with ventral margin widened in middle beyond gonopore then narrowed .... *veinatus* (Pruthi)
— Male subgenital plate gradually narrowed caudally, lateral margin either straight or concave in apical 0.33; aedeagus with ventral margin not as above 18
18. Aedeagus with ventral margin narrowly produced beyond gonopore; pronotum with black transverse stripe .... *bicolor* (Pruthi)
— Aedeagus with ventral margin not as narrowly produced as above, straight or slightly curved; pronotum without a transverse black stripe 19
19. Fore wing greyish-white with costal and claval margins and a median longitudinal band fuscous; male abdomen with basal apodemes broader than long .... *fletcheri* (Pruthi)
— Coloration not as above; abdominal apodemes of male longer than broad 20
20. Aeadeagus with gonopore restricted to apex .... *hospes* Kirkaldy
— Aedeagus with gonopore not restricted to apex 21
21. Style with apophysis slender, laterally curved and tapering caudally .... *intermedius* Melichar
— Style with apophysis rather robust, if slender then straight 22
22. Aedeagal shaft slender, elongate, 1.5 times as long as connective, strongly bisinuate .... *jagannathi* Dash and Viraktamath
— Aedeagal shaft rather stout, shorter than 1.25 times length of connective, not bisinuate 23
23. Apophysis of style bidentate ventrally, basal abdominal apodemes short, lobe-like .... *tareni* Dash and Viraktamath
— Apophysis of style with a single ventral tooth basal abdominal apodemes longer 24
24. Apex of aedeagal shaft acutely pointed in dorsal aspect .... *chhota* (Pruthi)
— Apex of aedeagal shaft not acutely pointed .... *krameri* (Rao and Ramakrishnan)

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NOTES ON THE LIFE HISTORY OF *CONCHYLOCTENIA NIGROVITTATA* (BOHEMAN) (COLEOPTERA: CHRYSOMELIDAE: CASSIDINAE)[1]

NILESH RANE, SACHIN RANADE AND H.V. GHATE[2]

(*With four text-figures*)

Key words: Chrysomelidae, Cassidinae, life cycle, *Conchyloctenia nigrovittata*, *Ipomoea eriocarpa*, tortoise beetle

The breeding of the rare tortoise beetle *Conchyloctenia nigrovittata* was observed under natural as well as laboratory conditions in Pune. The breeding period is July to October. The ootheca containing on an average 4 eggs, is deposited on the leaf of the host plant *Ipomoea eriocarpa*. The larvae are typically cassidine, with a flattened body and 16 pairs of lateral processes covered with spinules. The larvae undergo 4 moults and thus there are 5 larval instars. From the second instar onwards, they carry the moulted skin and faecal matter on the supra-anal processes. They pupate on the leaf surface. The pupa has a semicircular prothorax and 5 pairs of leaf-like lateral processes on the abdomen. It also carries the larval exuviae and a few threads of faecal matter. From the egg laying to the eclosion stage it takes around 30 days. The newly emerged imago is colourless, but develops its characteristic pattern of black patches within 3 hours, and its conspicuous red colour in 8-10 days. The imago requires about 6 to 10 days to reach sexual maturity.

INTRODUCTION

The genus *Conchyloctenia* Spaeth is distributed in India and Africa, except Madagascar (Maulik 1919, Borowiec 1994). In India, it is represented by one species, namely *C. nigrovittata* (Boheman), while there are 14 species in Africa (Borowiec 1994).

C. nigrovittata can be recognized because of its sub-oblong shape, bright red coloration and characteristic markings of black spots and patches. Another important character is that the claws are pectinate at the base on both sides. A detailed description is given by Maulik (1919) (Fig. 1).

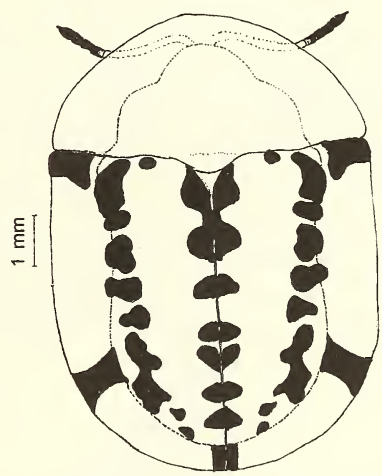

Fig.1: *Conchyloctenia nigrovittata* beetle with the general colour pattern. (Punctation and costae not shown.)

Maulik (1919) recorded this insect from Surat (Gujarat), Nagpur (Maharashtra) and Calcutta (West Bengal). The only other record is from near Mysore (Borowiec 1990: based on a specimen collected in 1953). Thus, *C. nigrovittata* has apparently not been reported from any part of India during the past 45 years. No information is available on its life cycle either. Even for the African species of *Conchyloctenia*

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there is scanty information regarding bionomics of two species only (Borowiec 1994). We are, therefore, reporting this species from Pune (Maharashtra), along with notes on its life history, for the first time.

Conchyloctenia nigrovittata was first collected at the base of Parvati Hills in Pune, in July 1996. Later, in July 1997, we collected some tortoise beetle larvae near the Pashan lake. These larvae looked different from the ones we had seen and reared before. They had long thin threads of faecal matter attached to the supra-anal processes. We collected them with their food plant, which was identified as *Ipomoea eriocarpa*, and allowed them to grow, pupate and eclose under laboratory conditions. The beetle that emerged was *C. nigrovittata*. Within a month, we found a few different looking oothecae on *Ipomoea eriocarpa* in the same area. We reared 3 out of 4 oothecae in the laboratory, and the larvae that hatched out were easily identified as those of *C. nigrovittata*. During July-October 1999, we monitored several oothecae and larvae in the field, as well as under laboratory conditions, and observed the various instars, feeding, growth, moulting, pupation and eclosion. The beetles and larvae were maintained in ordinary one litre plastic [PET] jars covered with muslin cloth, at a constant temperature of 25 °C in a B.O.D. incubator, with a supply of fresh leaves of the host plant.

Observations

Ootheca: The ootheca is generally small (length 3.2 to 3.8 mm and breadth 2.2 to 2.5 mm), yellowish-brown (reddish-brown when fresh), somewhat elliptical, and is deposited on the upper or lower surface of the *Ipomoea* leaves. It is attached to the leaf with secretion from the accessory glands, as in other tortoise beetles. It is made up of three to four translucent membranes deposited over each other. The eggs are deposited between the two inner membranes. The outermost membrane is a flap-like lid, attached only to one end of the ootheca. It has a characteristic pattern of fine, transverse ridges and can be lifted with forceps (Fig. 2). Each egg is green or greenish-yellow and is enclosed in a separate membrane of its own. There are usually 3 or 5 eggs per ootheca and these are deposited in two tiers. The average length of the egg is about 1.2 mm and breadth about 0.4 mm. In the field, as well as under laboratory conditions, the larvae hatch in about 6 days.

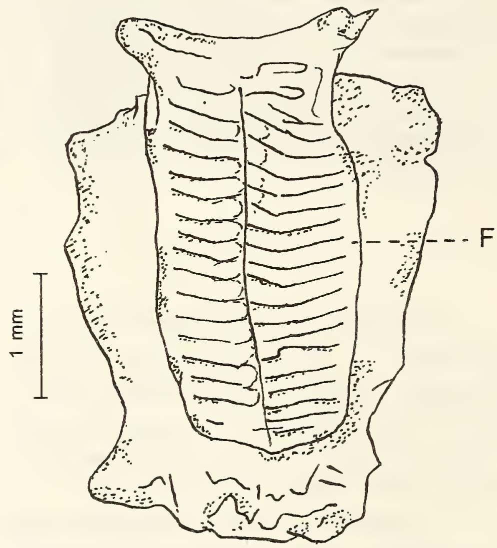

Fig. 2: Ootheca showing the characteristic fold pattern (F) and ridges as seen from above.

Larvae: The first instar larva is very small (about 1.3 mm) and a translucent pale green. During the next 3 days, it grows to about 2.2 mm before moulting. The second instar larva grows from about 2.2 to 2.7 mm before undergoing the next moult in 3 to 4 days time. This third instar grows to a length of about 4 mm in 3 days before moulting. The fourth and fifth instar larvae grow to about 5.3 and 8.4 mm respectively and the duration of each of these instars is about 4 days.

Up to the third instar, the larvae are pale green without any pigment pattern. In the fourth instar, however, the larvae develop a pattern of fine black spots. This pattern becomes bold and prominent in the fifth instar.

The larvae are more or less flattened overall, but with a somewhat convex dorsal surface. The larval head is oval and brown due to chitinisation and it is covered with many long and short setae. There are five lateral ocelli on each side of the head. The mandibles are prominent and possess five denticles, which are heavily chitinised. The larvae carry faecal matter, in the form of fine greenish-black threads, on their supra-anal processes. These faecal threads are very long and in the second instar the length of such threads is almost three times that of the body length. The larvae also carry the exuviae of previous instars. There are 16 pairs of lateral processes, each of which is provided with spinules, as shown for the fifth instar larva (Figs 3a & b). This figure also shows other structures such as the spiracles, faecal matter and colour pattern. The ventral aspect of the larva has no colour pattern or other notable features.

The larvae feed on the upper surface of the plant. The first and second instars only scrape the surface of the leaf, but the later instars cut holes and skeletonise the leaves. Feeding stops when the larva is about to pupate. The larva then becomes immobile and pupates on the leaf by attaching itself with the help of the three anterior abdominal segments (which become somewhat thicker at this stage).

Pupa: The pupa is translucent greenish-yellow, with a pattern of black spots, and is about 8 mm long. It retains all the larval skins in a folded form on the processes of the last abdominal segment. It also carries a few threads of faecal

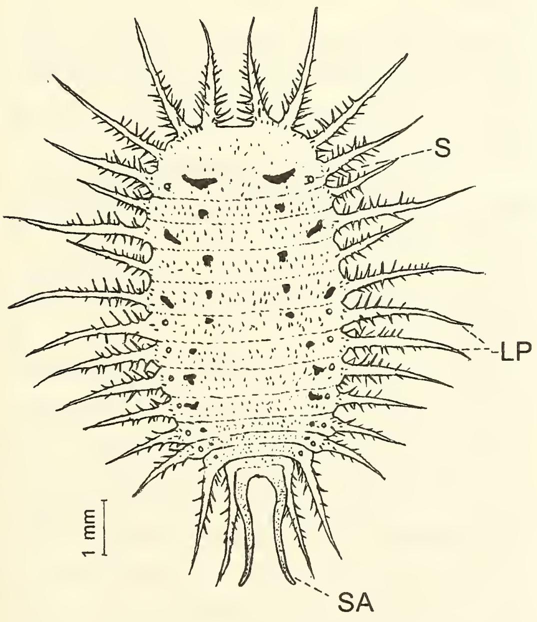

Fig. 3a: Fifth instar larva with typical lateral processes (LP) bearing spinules, spiracles (S) and supra-anal processes (SA).

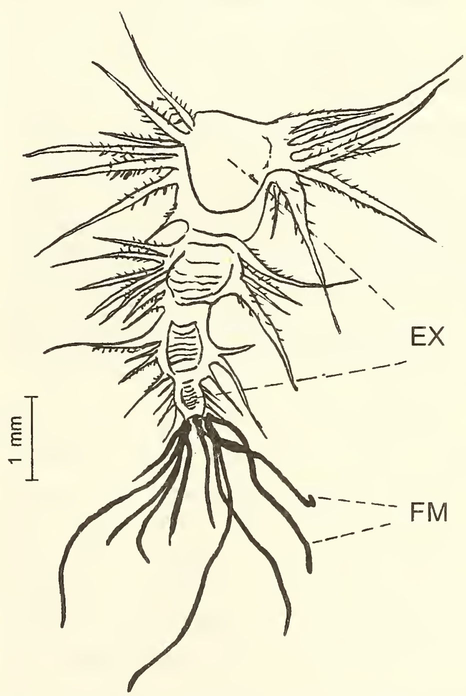

Fig. 3b: Complex exuviae (EX) and faecal matter (FM) carried by the fifth instar larva (detached and shown here).

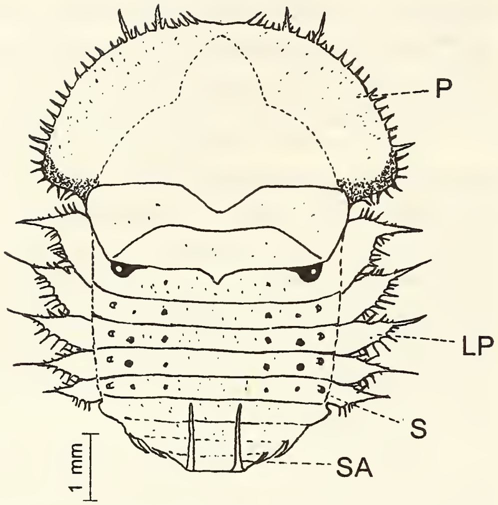

Fig. 4: Pupa showing pronotum (P), with a lining of spines anteriorly, and other thoracic segments. Abdominal segments with leaf-like lateral processes (LP), spiracles (S) and supra-anal processes (SA).

matter. The leaf-like lateral processes on the abdominal segments, spinules, and spiracles are clearly seen (Fig. 4). The five abdominal spiracles are very prominent, tubular and elevated. Each is surrounded by a dark area, the extent of which decreases posteriorwards. The antero-lateral leaf-like projections on the first to fifth abdominal segments have long, sharp spinules. The seventh segment has posteriorly directed processes while those on the eighth segment are somewhat ventrolateral.

Imago: The imago emerges from the pupa in about 5 days. The freshly emerged beetle is pale yellowish-green, translucent, and without black spots. Thin black elytral spots start appearing in about 20 to 30 minutes and become bold in about 2 to 3 hrs, to assume the typical pattern of the species. The insects first become yellowish-brown, then pinkish and finally deep red. The characteristic red colour appears after 8 to 10 days. The adult commences feeding within a few hours or may delay it up to 24 hrs. The species generally does not start feeding in the middle of the leaf as other tortoise beetles do, they restrict themselves to the leaf border. The average length of 26 beetles studied was 8.9 and breadth 6.1 mm.

The imago becomes sexually mature within 10 days and the female starts depositing oothecae within three to five days after mating. In the laboratory population in 1999, a single female usually deposited 3 or 4, sometimes 1 and rarely 5 oothecae per day, over a period of 10 days after mating. A total of 34 oothecae were deposited in 10 days. Hatching success was almost 95% under laboratory conditions, as there was no parasitisation by chalcid wasps, a phenomenon rather common in the oothecae of wild populations of tortoise beetles that we are studying (unpublished data).

Discussion

The life cycle of *Conchyloctenia nigrovittata* is completed in about 35 days. We have observed oothecae in natural conditions between July and October. The breeding season, therefore, appears to be the monsoon period.

The ootheca is recognisably different from those of the other common tortoise beetles, like *Aspidimorpha miliaris* (Fabricius) and *A. sanctaecrucis* (Fabricius), described earlier (Maulik 1919, Takizawa 1980, our own unpublished data). However, the ootheca of *C. nigrovittata* is similar to that of *Aspidimorpha furcata* (Thunberg) described by Takizawa (1980) and also studied in our laboratory. It is also much simpler in organization than that of *A. miliaris* or other complex oothecae described in considerable detail by Muir and sharp (1904).

Overall, the larvae of *C. nigrovittata* are typical cassidine larvae and carry threads of faecal matter like the larvae of *Aspidimorpha sanctaecrucis*. However, in *C. nigrovittata,* the threads are thinner and fewer in number. The

larva is also somewhat similar to that of *Aspidomorpha* (=*Aspidimorpha*) *tigrina*, as described in Muir Sharp (1904). [This African species is now transferred to the genus *Conchyloctenia*; see Borowiec, 1994.]

Carrying faecal matter is an interesting adaptation shown by the larvae and pupae of cassidine beetles. Takizawa (1980) even classified the various patterns of faecal matter carried by the larvae (filament type, shield type, spade type and mass type). Takizawa (1980) further attempted to find the relationship among the different tribes of the family Chrysomelidae, on the basis of oothecal structure, and larval and pupal characters.

It is said that the faecal shield protects the larvae from predators and, to a certain extent, from parasitoids. Use of waste matter by chrysomelid larvae has been the topic of interest for many workers. The reader is referred to an excellent discussion regarding these aspects by Olmstead (1994).

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TERRESTRIAL MOLLUSCS FROM NEPAL[1]

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(*With one text-figure*)

Key words: Mollusca, terrestrial, Nepal

Eleven species of terrestrial molluscs have been listed from 12 districts of Nepal. They represent 5 families under 3 orders. Of the eleven species, 6 belong to the Family Ariophantidae, 2 to Cyclophoridae and 1 each to Stenogyridae, Veronicellidae and Helicidae.

INTRODUCTION

Nepal is a landlocked Himalayan kingdom, situated between 80° 00'-88° 15' E, and 26° 30'-30° 15' N. The country has been divided into 5 development regions, which are further divided into 14 zones, with 75 districts. Out of the total area of 1,41,000 sq. km, the majority is occupied by land.

A perusal of the literature reveals paucity of information regarding the terrestrial molluscs of Nepal. Godwin-Austen (1910) and Majupuria (1981-1982) have reported a few species of terrestrial and freshwater molluscs collected from Nepal and Kathmandu valley. This report is the second of a series on the molluscan fauna of Nepal, the first being on the freshwater molluscs from the same area (Subba and Ghosh 2000). The present work is an attempt to list the terrestrial molluscan species collected during a survey of 12 districts of Nepal. The surveys were initiated in 1993, to identify and list the terrestrial as well as freshwater molluscan species of Nepal.

MATERIAL AND METHODS

A collection of terrestrial molluscs was made from various sites, representing humid, shady and rocky places in the forests, gardens, fields, river banks, and around lakes and ponds. The 12 districts surveyed were Ilam, Jhapa, Morang, Sunsari, Dhankuta, Saptari, Udayapur, Kathmandu, Lalitpur, Kaski, Gulmi and Rupandehi, representing six zones (Mechi, Koshi, Sagarmatha, Bagmati, Lumbini and Gandaki) of eastern, central and western Nepal (Fig. 1). The shape, colour and habitat of the molluscan samples, from these collection sites, were recorded. For further morphological studies, specimens were preserved in 70% ethanol. Molluscan shells were washed and dried, and kept in plastic containers, or small vials with cotton, for identification.

Identifications were made with the help of literature, including Cooke *et al.* (1896) and Raut and Ghose (1984). All samples were sent to the Zoological Survey of India, Kolkata for confirmation of identification.

RESULTS AND DISCUSSION

A total of 11 species of terrestrial molluscs were found from 7 eastern, 2 central and 3 western districts of Nepal. Out of the 11 species, 1 belongs to the order Soleolifera, 2 to Mesogastropoda and the remaining 8 to Stylommatophora (Table 1). Distribution pattern of the terrestrial molluscs in the 12 districts of Nepal has been shown in Fig. 1. Some information on their habitat and distribution is given below:

Cyclophorus fulguratus was recorded from different places in the Terai and Siwalik hills

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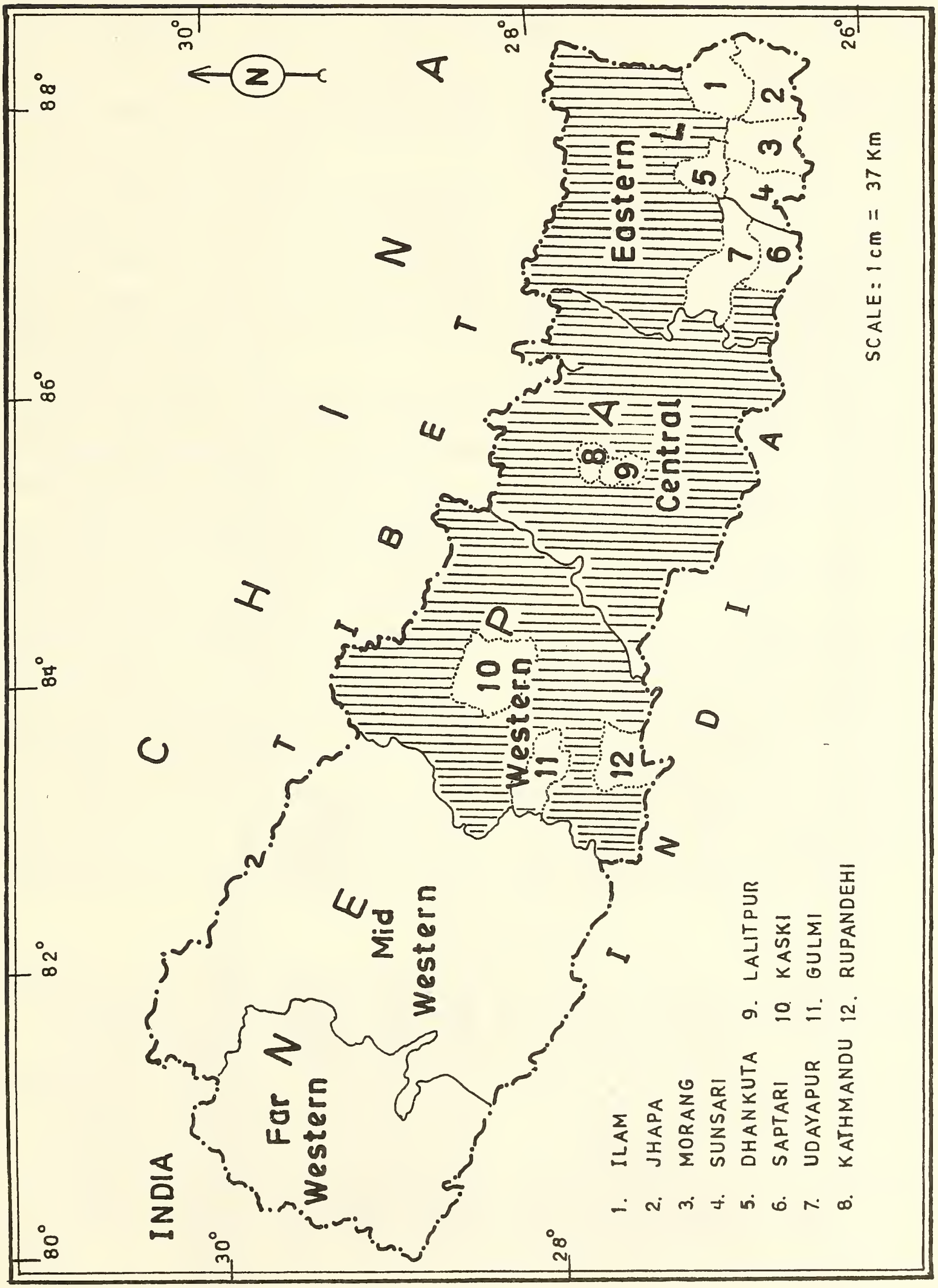

Fig. 1: Distribution of terrestrial molluscs in Nepal

LAND MOLLUSCS OF NEPAL AND THEIR DISTRIBUTION IN DIFFERENT DISTRICTS

S.N.	Genus	Species	Family	Sites of collection											
				Ila	Jha	Mor	Sun	Dhan	Sapt	Ud	Kath	Lal	Gul	Kash	Rup
1.	*Cyclophorus* Pfeiffer	*fulguratus*	Cyclophoridae	+	+	+	+	+	-	+	-	-	+	-	-
2.	*Cyclophorus* (Schumacher)	*aurantiacus*	"	+	-	+	+	+	-	+	-	-	-	-	-
3.	*Macrochlamys* Godwin-Austen	*indica*	Ariophantidae	+	-	-	+	+	-	-	+	+	+	+	-
4.	*Macrochlamys* (Benson)	*tugurium*	"	+	-	-	-	+	-	-	+	+	+	+	-
5.	*Bensonia* (Blanford)	*nepalensis*	"	+	-	-	-	+	-	-	+	+	+	+	-
6.	*Oxytes* (Blanford)	*sylvicola*	"	+	-	+	+	+	-	+	+	+	+	+	+
7.	*Khasiella* (Benson)	*pansa*	"	+	+	+	+	+	+	+	-	-	-	+	+
8.	*Cryptaustenia*	unidentified	"	-	-	-	-	-	-	-	-	-	-	+	-
9.	*Achatina* (Bowdich)	*fulica*	Stenogyridae	-	+	+	+	-	+	-	-	-	-	-	-
10.	*Laevicaulis*	unidentified	Veronicellidae	+	-	-	-	-	-	-	-	-	-	-	-
11.	*Anadenus*	unidentified	Helicidae	+	-	-	-	+	-	-	+	+	+	+	-

Ila-Ilam; Jha-Jhapa; Mor-Morang; Sun-Sunsari; Dhan-Dhankuta; Sapt-Saptari; Ud-Udayapur; Kath-Kathmandu; Lal-Lalitpur; Gul-Gulmi; Kash-Kashki; Rup-Rupandehi

+: species presents, -: species absent

(Churia hills) up to 1,500 m. It prefers to inhabit old walls and stones covered with algae and moss, which is perhaps used as food. *C. aurantiacus* is larger than *C. fulguratus*. It was recorded from the Terai region, Churia hills (1,500 m) and Mahabharat hills (1,676 m), but is more common at Churia hills.

A good collection of *Macrochlamys indica*, *M. tugurium* and *Bensonia nepalensis* was made from the Mahabharat hills. These species were found in rocky or stony regions covered with algae and moss, hidden under stones and dry leaves during the dry season.

Oxytes sylvicola ranged from the Churia hills to the middle of the Mahabharat hills (1,658 m) of eastern and central Nepal. Stony places with decayed leaves seemed to be a suitable habitat.

Khasiella pansa was common at several places in the Terai, Churia hills and Mahabharat hills of eastern Nepal. It was not recorded from any of the districts surveyed in central and western Nepal. It generally climbs up shrubs and remains adhered to the under surface of green leaves. *Cryptaustenia* sp. was recorded from similar habitats in Kashki district, western Nepal. Interestingly, that was the sole record.

Achatina fulica, or large garden snail (giant African snail) was the largest terrestrial mollusc recorded. It is restricted to the humid subtropical areas of the Terai and lower part of Churia hills, from eastern and central Nepal. This snail is notorious for its damage to vegetables and fruits.

Laevicaulis sp., a small slug, was recorded in the Terai of eastern Nepal, inhabiting nearby water sources such as fish ponds, reservoirs, water channels and paddy fields.

Anadenus sp., or *Chiple Kira*, one of the largest highland molluscs, was recorded from the Mahabharat hill range between 1,828 m and 2,735 m, from eastern and central Nepal. Its habitat is similar to that of *Laevicaulis* sp.

This survey gives some valuable information on the distribution of terrestrial molluscs in eastern, central and western Nepal. However, a district level survey of other regions of Nepal must be made, before any biogeographical conclusions are drawn.

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■ ■ ■

NEW DESCRIPTIONS

DELTOCEPHALINE LEAFHOPPER GENUS *GONIAGNATHUS* (HEMIPTERA : CICADELLIDAE) IN THE INDIAN SUBCONTINENT WITH DESCRIPTIONS OF FOUR NEW SPECIES[1]

Pratap Chandra Dash[3] and C.A. Viraktamath[2]

(*With sixty-five text-figures*)

Key words: Leafhoppers, *Goniagnathus*, Indian subcontinent, new species, Cicadellidae

Five of the six valid species of the genus *Goniagnathus* Fieber known from the Indian subcontinent, namely *G. appellans* Baker, *G. fumosus* Distant, *G. guttulinervis* (Kirschbaum), *G. nervosus* Melichar and *G. punctifer* (Walker) are redescribed and illustrated. *G. bifurcata* Ahmed & Qadeer known from Karachi (Pakistan) is treated here as a junior synonym of *G. guttulinervis* (Kirschbaum). Four new species, namely *Goniagnathus concavus* sp. nov., *G. quadripinnatus* sp. nov., *G. symphysis* sp. nov., and *G. syncerus* sp. nov., have been described and illustrated. Three groups of species have been recognised in the genus *Goniagnathus*; i) the *guttulinervis* group which includes *guttulinervis* (Kirschbaum), *obfuscatus* Linnavuori, *parvipictus* Linnavuori, *albomarginatus* Linnavuori and *hanifanus* Dlabola, ii) the *punctifer* group including *appellans* Baker, *concavus* sp. nov., *fumosus* Distant, *nervosus* Melichar, *punctifer* (Kirschbaum), *quadripinnatus* sp. nov. and *appendiculatus* Linnavuori, and iii) the *syncerus* group including *symphysis* sp. nov. and *syncerus* sp. nov. A key to the species of *Goniagnathus* from the Indian subcontinent is also included.

Introduction

The deltocephaline genus *Goniagnathus* Fieber belongs to the tribe Goniagnathini and includes very distinctive leafhoppers having short and broad heads, male subgenital plates fused and the connective reduced and fused with the aedeagus. They are brown to dark brown, robust leafhoppers, breeding on grasses and herbs. The genus is known to occur in the Palaearctic (28 species), Afrotropical (13 species) and the Oriental regions (7 species). Linnavuori (1978), while revising the genus for the Afrotropical region, redefined the tribe as well as the genus. Distant (1908, 1918) added six species of *Goniagnathus* from the Indian subcontinent. However, Kumar (1983) transferred *G. uniformis* Distant to the genus *Batracomorphus* Lewis. Ahmed *et al.* (1988) described *G. bifurcatus* Ahmed and Qadeer as a new species from Karachi (Pakistan). Rama Subba Rao (1994) recorded *G. guttulinervis* (Kirschbaum) from the Indian subcontinent, in addition to redescribing *G. nervosus* Melichar from Kerala, thus bringing the total number of species to seven.

The institutions from where the leafhopper study material was obtained, and their abbreviations, are as follows.

BMNH - The Natural History Museum, London, U.K.

NPC - National Pusa Collection, Indian Agricultural Research Institute, New Delhi.

MMB - Moravian Museum, Brno, Czech Republic

UAS - The University of Agricultural Sciences, GKVK, Bangalore.

No attempts were made to redescribe *Goniagnathus*, as Linnavuori (1978) has given a detailed description. However, the following additional characters are noted. Hind tibial

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spinulation R_1 10±2, R_2 10±2, R_3 17-22. Platellae at apex of hind basitarsus are five in number, flanked by a spine on each side. Female seventh sternum broader than long, hind margin variously excavated in the middle or concave. The first pair of female valvulae has scale-like sculpturing. The second pair of valvulae bear prominent teeth on dorsal margin and with crenulate margin between teeth and ventroapical margin.

On the basis of the male genitalia, the species studied and recognised here can be divided into three groups.

1. **The *guttulinervis* group**: Male pygophore without dorsal appendage, lobes with numerous setae. Aedeagus complex, with a pair of ventral atrial processes exceeding the compressed, short, simple shaft. The group includes only *G. guttulinervis* (Kirschbaum) from India. However, the following species from other zoogeographical regions also belong to this group: *G. obfuscatus* Linnavuori, *G. parvipictus* Linnavuori, *G. albomarginatus* Linnavuori (all from Afrotropical region, Linnavuori 1978) and *G. hanifanus* Dlabola (from Iran, Dlabola 1981).

2. **The *punctifer* group**: Male pygophore lobe with dorsal appendage, setae sparse. Aedeagus with tubular shaft having apical and subapical elongate processes. This group includes *G. appellans* Distant, *G. concavus* sp. nov., *G. fumosus* Distant, *G. nervosus* Melichar, *G. punctifer* (Walker) and *G. quadripinnatus* sp. nov. from the Indian subcontinent. *G. appendiculatus* Linnavuori from the Afrotropical region (Linnavuori 1978) also belongs to this group.

3. **The *syncerus* group**: Similar to the *punctifer* group in pygophore structure, but the aedeagal shaft is shorter, widening caudally. The gonopore is surrounded by a short, sclerotized process. This group comprises of only two species, *G. symphysis* sp. nov. and *G. syncerus* sp. nov.

Key to species of *Goniagnathus* of the Indian subcontinent

(*G. bicolor* Distant is not included in the key)

1. Male 2
— Female 10
2. Male pygophore without dorsal appendage (Figs 1, 60) 3
— Male pygofer with dorsal appendage (Figs 7, 14, 21) 4
3. Aedeagus with a pair of ventral processes exceeding shaft (Fig. 3) (Palaearctic and Oriental) .... *G. guttulinervis* (Kirschbaum)
— Aedeagus without ventral process (Fig. 63) (India: Rajasthan) .... *G. syncerus* sp. nov.
4. Aedeagus with long processes; shaft rather tubular, long and of uniform width 5
— Aedeagal shaft without any long process, constricted before apex (Figs 56, 57); gonopore surrounded by sclerotized rim ending in a lateral short projection (Fig. 55) (India: Gujarat, Maharashtra, Karnataka, Tamil Nadu .... *G. symphysis* sp. nov.
5. Pygophore lobe strongly narrowed caudally with its appendage bordering caudo-dorsal margin only (Figs 7, 39) 6
— Pygophore lobe broad or broadened caudally, with its appendage bordering both caudo-dorsal and caudal margins (Figs 21, 31) 9
6. Fused subgenital plates with concave caudal margin (Fig. 15); aedeagal shaft with a pair of ventral and a pair of dorsal processes at apical. 0.33 (Figs 17, 18) (India: Gujarat, Karnataka) .... *G. concavus* sp. nov.
— Fused subgenital plates either with truncate, convex or obtusely rounded caudal margin; aedeagal shaft with lateral and dorsal or lateral and apical processes 7
7. Aedeagus with a pair of apical and a pair of rather asymmetrically curved processes arising at mid-length of shaft dorsally (Figs 41, 42); fused subgenital plates square tipped (Fig. 40) (India: Gujarat, Maharashtra, Karnataka, Mizoram, Meghalaya, Kerala; Sri Lanka) .... *G. punctifer* (Walker)
— Aedeagus with a pair of apical and a pair of subapical processes; fused subgenital plates obtusely or convexly rounded 8

8. Fused subgenital plates broader at base than long, caudally convexly rounded (Fig. 46); apophysis of style with mesal lobe stouter and longer than lateral lobe (Fig. 47); lateral processes of aedeagal shaft stouter and longer than dorsal processes (Figs 48, 49) (India: Orissa, Karnataka) .... *G. quadripinnatus* sp. nov.
— Fused subgenital plate as long as broad basally, narrowed caudally (Fig. 8), apophysis of style with equally developed lateral and mesal lobes (Fig. 9), lateral processes of aedeagal shaft slender and shorter than dorsal processes (Fig. 10) (India: West Bengal, Meghalaya, Maharashtra, Karnataka, Kerala, Lakshadweep Islands) .... *G. appellans* Baker
9. Fused subgenital plate with truncate hind margin, style extending beyond this plate (Figs 22, 23); aedeagal shaft with a pair of forked apical processes (Fig. 25) (India: Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh) .... *G. fumosus* Distant
— Fused subgenital plate with caudal margin slightly convex, medially notched (Fig. 32); styles not exceeding length of this plate; aedeagal shaft with a pair of dorsal, an unpaired ventral subapical process and a pair of basal prong-like processes (Fig. 33) (India: Andhra Pradesh, Maharashtra, Karnataka, Pondicherry, Kerala; Sri Lanka) .... *G. nervosus* Melichar
10. Hind margin of seventh sternum concave (Fig. 28) or concavely excavated in the middle 11
— Hind margin of seventh sternum broadly produced caudally with a median notch (Fig. 44) .... *G. punctifer* (Walker)
11. Hind margin of seventh sternum moderately concave; with a median notch (Fig. 37) 12
— Hind margin of seventh sternum deeply concave, without a median notch (Figs 28, 29) .... *G. fumosus* Distant
12. Caudo-lateral angle of seventh sternum angular (Figs 13, 58) 13
— Caudo-lateral angle of seventh sternum rounded (Figs 5, 37, 50) 14
13. Hind margin of seventh sternum with a median V-shaped excavation (Fig. 58) ....
.... *G. symphysis* sp. nov.
— Hind margin of seventh sternum with a median C-shaped excavation (Fig. 13) ....
.... *G. appellans* Baker
14. Seventh sternum with median length considerably shorter than lateral length 15
— Seventh sternum with median length as long as lateral length (Fig. 37) ....
.... *G. nervosus* Melichar
15. Seventh sternum with a median V-shaped excavation (Fig. 5) ....
.... *G. guttulinervis* (Kirschbaum)
— Seventh sternum medially roundly excavated with lateral margins sinuate (Fig. 50) .... *quadripinnatus* sp. nov.

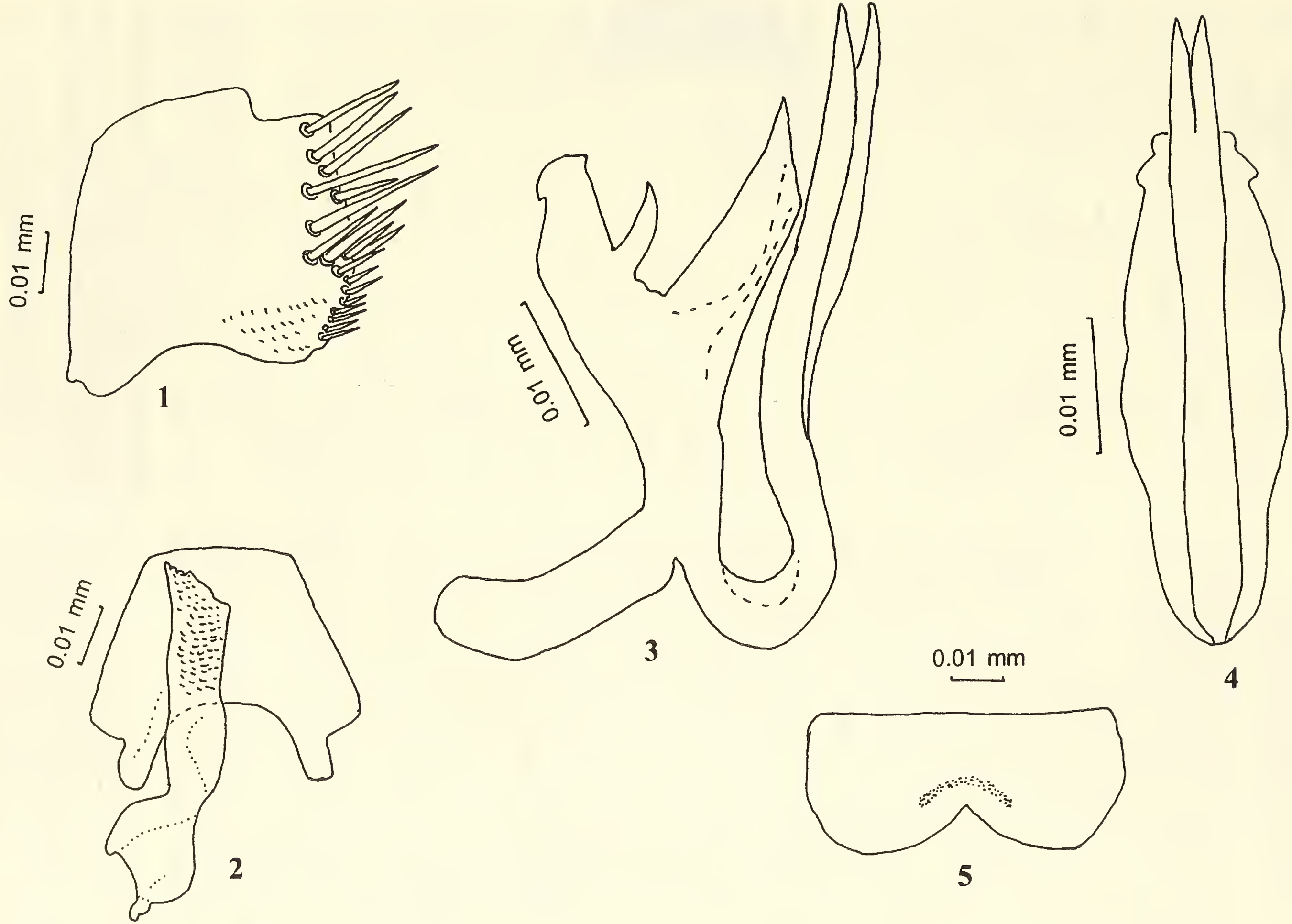
Goniagnathus guttulinervis (Kirschbaum)
(Figs 1-5)

Goniagnathus bifurcatus Ahmed and Qadir in Ahmed *et al.*, 1988: 16. syn. nov.

This species has been well described and hence only the illustrations of the male and female genitalia of the Indian population are included.

Material examined: INDIA: Lakshadweep Is.: 16♂, 20♀, 13 nymphs, Minicoy, 16.i.1986, C.A. Viraktamath; 1♂, Bangaram, 14.i.1986, C.A. Viraktamath. Delhi: 15♂, 9♀, New Delhi, 1968, H.M. Harris; 1♂, 7.vii.1972; 2♂, 1.viii.1974; 3♂, 1♀, 4.x.1980, C.A. Viraktamath. Maharashtra: 1♀, Dhond, 2.x.1981, C.A. Viraktamath; 2♂, 6♀, Igatpuri, 23.iv.1980, C.A. Viraktamath. Gujarat: 1♀, Somnath, 29.i.1981, C.A. Viraktamath; 1♀, Dandi-Navsari, 16.i.1981, C.A. Viraktamath. Tamil Nadu: 1♀, Coimbatore, 14.viii.1979, S. Viraktamath. Rajasthan: 2♂, 2♀, Mt. Abu, 23-24.i.1981, C.A. and S. Viraktamath. Karnataka: 2♂, Raichur, 25.vi.1982, S. Viraktamath (UAS).

Remarks: *G. guttulinervis* can be recognised by the absence of dorsal pygophore appendage, lamellate aedeagal shaft arising from the long basal atrium at mid-length and with long falcate appendage on ventral aspect. Synonymy of *G. bifurcatus* is based on the study of male genitalia given by Ahmed *et al.* (1988).



Figs. 1-5. *Goniagnathus guttulinervis* (Kirschbaum): 1. Male pygophore; 2. Fused subgenital plate and apex of style; 3. Fused aedeagus and connective, lateral view; 4. Aedeagus and ventral process, caudal view; 5. Female seventh sternum.

Goniagnathus appellans Baker
(Figs 6-13)

Goniagnathus obesus Distant, 1918: 43. Lectotype ♂, India (BMNH, examined).

Goniagnathus appellans Baker, 1924: 367, new name for *Goniagnathus obesus* Distant, 1918 not Jacobi, 1910.

Ochraceous with reddish tinge on the vertex, pronotum and scutellum. Anterior margin of vertex with black and reddish-brown transverse bands. Interrupted black facial pattern. Antennal pit black, clypellus, lora and genae with irregular black markings.

Vertex four times as wide as long. Forewing with inner anteapical cell open behind and outer anteapical cell divided with a cross vein.

Male genitalia: Pygophore with dorsal appendage stout, not exceeding caudo-dorsal margin, lobe caudally narrowed and obtusely rounded with short marginal setae. Fused subgenital plate as long as broad, caudally rounded. Apophysis of style bilobed with prominent scale-like sculpturing, inner lobe longer than outer. Aedeagal shaft tubular, elongate, of uniform width, slightly curved, with an apical pair of long, anteriorly directed processes and a shorter subapical pair of anterolaterally directed processes, gonopore small, apical; dorsal apodeme 0.33x as long as shaft and half as long as preatrium.

Female genitalia: Seventh sternum width 3.0 times the median length, hind margin sinuate with a median notch.

Measurements: MALE 5.4 (5.1-5.9) mm long, 2.3 (2.1-2.5) mm wide across eyes. FEMALE 5.6 (5.3-6.2) mm long, 2.3 (2.2-2.5) mm wide across eyes.

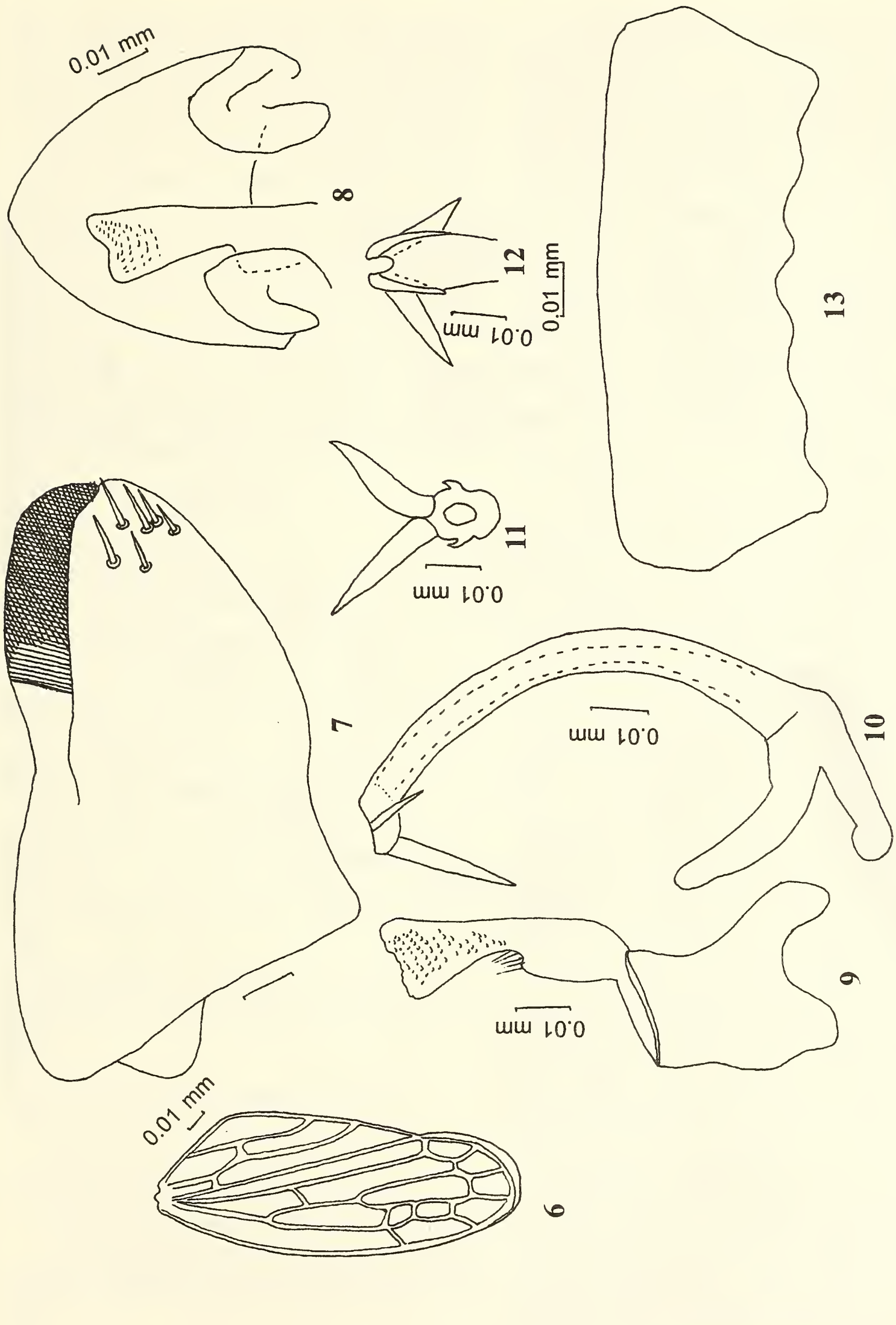
Material examined: Lectotype ♂, left hand male of the two dissected males on the same card "Chikkaballapura, T.V. Campbell" "*Goniagnathus obesus* Dist. Type" designated here (BMNH). Paralectotypes: 34 ♀♂, with same data as in lectotype (BMNH).

Other material examined: INDIA: Karnataka: 2♀, Bangalore, 22.v.1991; 1♂, 1♀, 23.x.1991; 7♂, 7♀, 3.xii.1991; 7♂, 4♀, 1.vii.1992; 4♂, 1♀, 2.ix.1991; 2♀, 20.vii.1991; 10♂, 4♀, 10.ii.1992; 3♂, 9♀, 2.xi.1991; 4♀, 3.vi.1992; 1♀, 12.vii.1992, 1♀, 6.xi.1991, 1♂, 30.vi.1992; 1♂, 25.vi.1992, all coll. P.C. Dash; 2♂, 10.vii.1982, H.V.A. Murthy; 3♂, 4♀, 14.ix.1925, T.V. Subramanian; 1♂, 4♀, 5.vii.1977; 1♂, 12.vii.1979; 1, 24.i.1977, all collected by students; 4♂, 1♀, 8.iv.1976, B. Mallik; 3♂, 22.iv.1974; 2♂, 21.ii.1976; 1♀, 11.i.1975; 1♂, 6.ix.1974; 2♂, 21.i.1976; 1♀, 1.ii.1974, all coll. C.A. Viraktamath; 1♂, 1♀, 12.v.1990, A.R.V. Kumar; 6♂, 4♀, 26 km SE Bangalore, 6.ix.1992, P.C. Dash; 1♂, Nandi Hills, 17.vii.1992, P.C. Dash; 1♀, Dharwad, 22.iv.1972; 1♂, 21.v.1972; 6♂, 2♀, 14-30.viii.1972, all coll. C.A. Viraktamath; 4♂, 2♀, Raichur, 24.viii.1982; 1♂, 25.vi.1982, S. Viraktamath; 3♂, 1♀, Raichur, 18-21.ii.1976, C.A. Viraktamath; 2♂, 4♀, Sidlaghatta, 9.viii.1976, B. Mallik; 1♀, 1♂, Gulburga, 24.vii.1981; 1♀, 9.ix.1990, A.R.V. Kumar; 2♀, Bidar, 5.i.1991, A.R.V. Kumar. Kerala: 1♂, Walayar, 15.viii.1979, S. Viraktamath. Maharashtra: 1♂, 2♀, Nasik, 21.iv.1980, C.A. Viraktamath. West Bengal: 1♀, 9 km E Kalimpong 1,768 m, 29.x.1981, C.A. Viraktamath. Meghalaya: 1♀, Nangpoh, 762 m, 4.xi.1981, C.A. Viraktamath. Lakshadweep Islands: 1♀, Minicoy, 16.i.1986, C.A. Viraktamath (UAS).

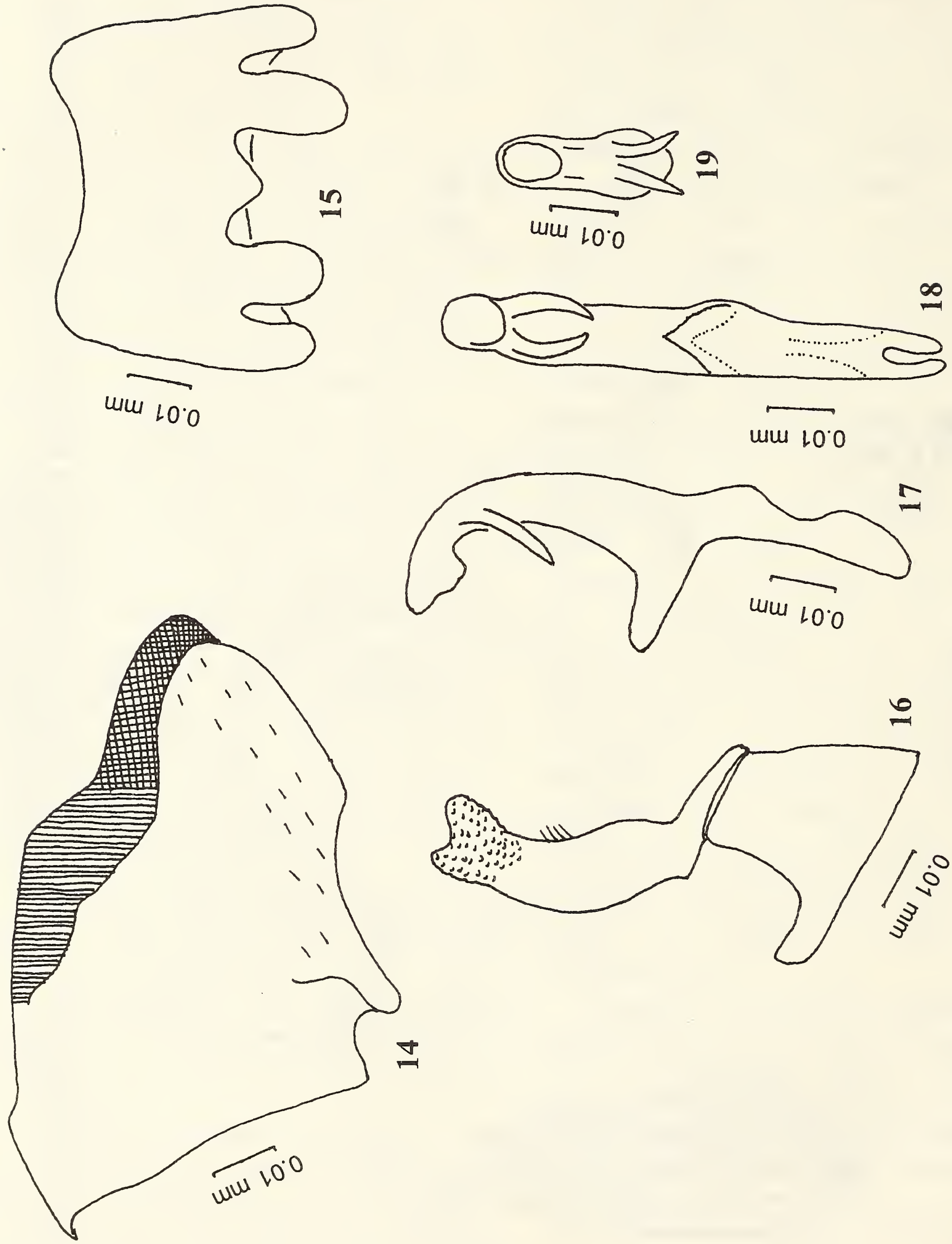
Remarks: The structure of aedeagus of *G. appellans* is similar to that of *G. severus* (Stål), but has completely fused subgenital plates. It is related closely to *G. quadripinnatus* sp. nov., from which it differs in the shape and size of the aedeagal processes and subgenital plate.

Goniagnathus concavus sp. nov.
(Figs 14-19)

Reddish-brown; anterior margin of the



Figs 6-13: *Goniagnathus appellans* Baker: 6. Fore wing; 7. Male pygophore; 8. Fused subgenital plate and apex of style; 9. Style; 10. Fused connective and aedeagus, lateral view; 11, 12. Different views of apex of aedeagal shaft; 13. Female seventh sternum.



Figs 14-19: *Goniagnathus concavus* sp. nov.: 14. Male pygophore; 15. Fused subgenital plate; 16. Style; 17. Fused connective and aedeagus, lateral view; 18. Same, cephalic view; 19. Apex of aedeagal shaft.

vertex ivory, with dorsal and ventral broken brown stripes. Forewing venation mottled with white and brown. Legs transversely banded with dark brown, and bases of hind tibial spines black.

Vertex four times as wide as long. Forewing with inner anteapical cell closed behind by a cross vein.

Male genitalia: Pygophore longer than its height, dorsal appendage heavily sclerotised, black, not extending down caudal margin, setae slender, hair-like. Fused subgenital plate twice as broad as median length, caudal margin inwardly curved. Apophysis of style strongly bilobed apically. Aedeagus slender, tubular, distal 0.25 strongly dorsally recurved; a pair of dorsal and a pair of ventral processes on shaft at distal 0.33; gonopore caudal.

Female: Unknown.

Measurements: MALE 5.75 (5.6-5.9) mm long, 2.3 (2.2-2.4) mm wide across eyes.

Material examined: Holotype ♂ INDIA: Gujarat: Ahmedabad, 27.i.1981, C.A. Viraktamath (UAS). Paratypes: INDIA: Gujarat: 1♂, Dandi-Navsari, 16.i.1981, C.A. Viraktamath. Karnataka: 1♂, Bangalore, 916 m, 9.i.1980, A.R.V. Kumar (BMNH, UAS).

Remarks: This species differs from other species of *Goniagnathus* in having abruptly recurved apex of aedeagal shaft and inwardly curved caudal margin of the fused subgenital plate.

Etymology: *concavus* refers to the concave hind margin of the fused subgenital plates of the male.

Goniagnathus fumosus Distant
(Figs 20-29)

Goniagnathus fumosus Distant, 1918; 43. Lectotype ♂, India (BMNH, examined).

Coloration as described by Distant (1918).

Vertex six times as wide as long. Forewing with inner anteapical cell closed behind by a cross vein.

Male genitalia: Pygophore with dorsal appendage reaching ventral margin, lobe caudoventrally produced into an angular prolongation without setae. Fused subgenital plates rectangular with rounded lateral margin, twice as broad as long. Apophysis of style with stout, elongated inner lobe and slender, smaller outer lobe; inner lobe exceeding fused subgenital plates. Aedeagal shaft tubular, with a pair of forked apical processes, mesal fork directed anteriorly, lateral fork laterally; gonopore large, apical; dorsal apodeme 0.33x as long as shaft, half as long as preatrium.

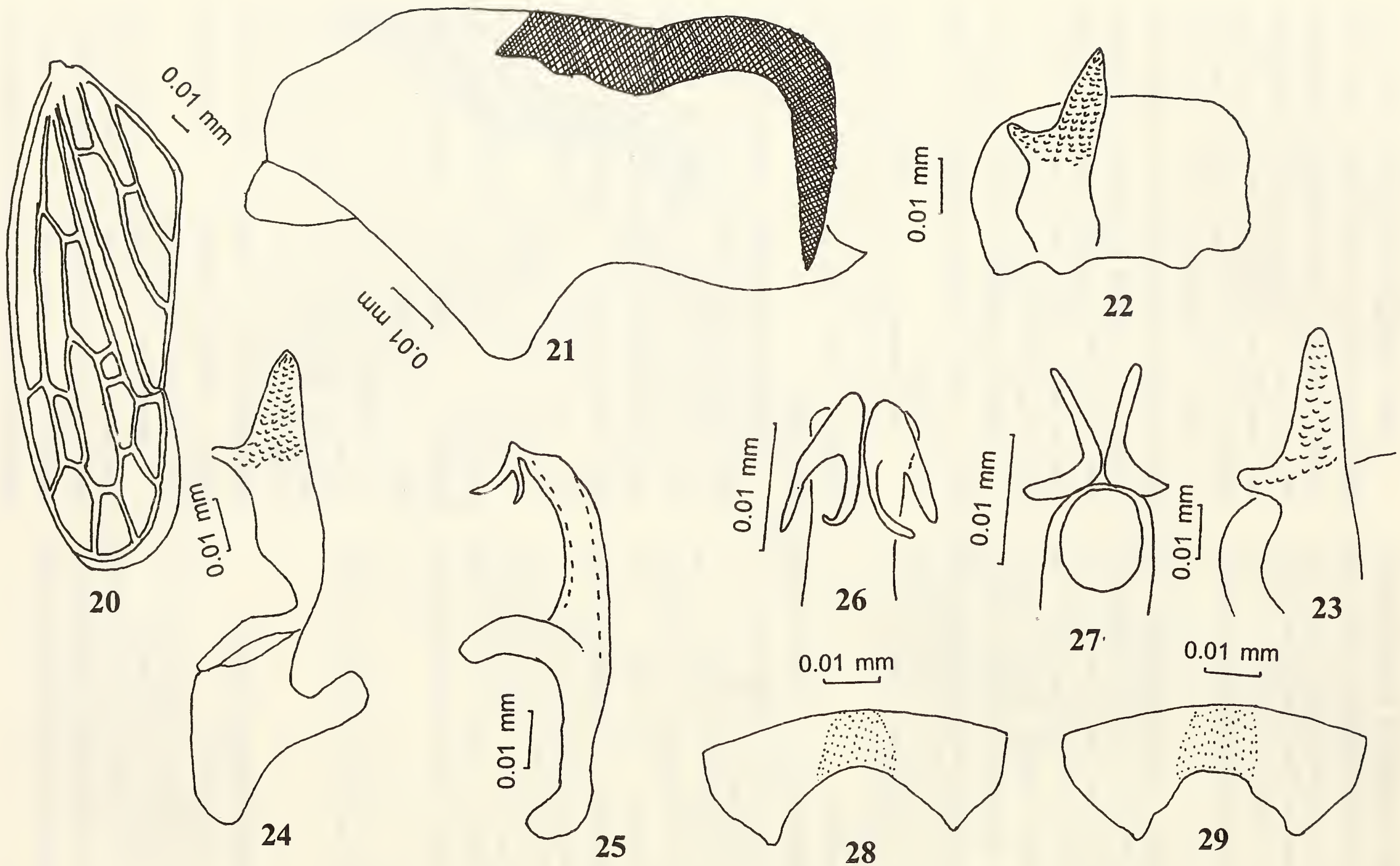
Female genitalia: Seventh sternum 3.0 times as wide as median length, hind margin deeply concave.

Measurements: MALE: 6.7 (6.4-6.8) mm long, 2.5 (2.4-2.6) mm wide across eyes. FEMALE: 6.3 (5.9-6.7) mm long, 2.5 (2.4-2.6) mm wide across eyes.

Material examined: Lectotype ♂, left hand male of the two dissected males on the same card "Chikkaballapura, S. India, T.V.C." "*Goniagnathus fumosus* Dist. Type" here designated (BMNH). Paralectotypes: 4♂, 5♀, data as for lectotype; 2♀, "Pusa Bihar, at light, TBF, 1.vii.14"(*sic*) 1♀, "Allahabad, August 1911, A.D. Imms" (BMNH).

Other material examined: INDIA: Karnataka: 2♀, Bangalore, (-).ix.1969, H.M. Harris; 1♀, 1.iv.1980, C.A. Viraktamath. Tamil Nadu: 2♂, 2♀, Trichy, 3-13.v.1989, K.R. Rao; 2♂, Pudukottai, 26.i.1985, K.R. Rao; 1♂, Kottampatty, 8.v.1984, K.R. Rao. Gujarat: 1♂, Junagadh, 30.1.1981, C.A. Viraktamath; 1♀, Sasan-Gir, 1.ii.1981, C.A. Viraktamath, Maharashtra: 1♂, 1♀, Dhond, 2.x.1981, A.R.V. Kumar. Andhra Pradesh: 1♂, Hyderabad, 30.iv.1992, ex. paddy (UAS).

Remarks: This species can easily be recognised by the forked aedeagal processes, dorsal pygophore appendage caudally abruptly curved at right angles and by the extension of apophysis of style beyond fused subgenital plates.



Figs 20-29: *Goniagnathus fumosus* Distant: 20. Forewing; 21. Male pygophore;
22. Fused subgenital plate and apex of style, specimen from Bangalore; 23. Apex of style, lectotype; 24. Style, specimen from Bangalore;
25. Fused connective and aedeagus, lateral view; 26, 27. Different views of apex of aedeagal shaft;
28, 29. Variation in the female seventh sterna.

Goniagnathus nervosus Melichar
(Figs 30-37)

Goniagnathus nervosus Melichar, 1903: 180. Lectotype ♂, designated here by P. Lauterer, Sri Lanka (MMB, examined).

Reddish-brown, anterior margin of vertex ochraceous. Interrupted black fascia on face, vertex, pronotum and scutellum mottled with irregular reddish-brown spots. Forewing veins mottled with dark brown and white spots.

Vertex five times as wide as long. Forewing with inner anteapical cell closed behind by a cross vein.

Male genitalia: Pygophore constricted at mid-length and broadened caudally with a few hair-like setae apically, dorsal appendage entire caudal margin. Fused subgenital plate twice as broad as long, slightly convexly rounded with a median notch on caudal margin. Apophysis of style bilobed. Aedeagal shaft strongly curved caudo-dorsally and in apical 0.25 strongly curved anteriorly, with a basal pair of lateral short, stout processes at 0.25 distance, a slender elongate unpaired process on caudal margin directed caudo-dorsally at apical 0.33 and a pair of ventrally directed, slender processes arising subapically on anterior margin; gonopore large, apical; dorsal apodeme 0.25 as long as shaft, shorter than preatrium.

Female genitalia: Seventh sternum 2.5 times as wide as long, hind margin sinuate with a median notch.

Measurements: MALE: 6.3 (6.2-6.4) mm long, 2.4 (2.3-2.5) mm wide across eyes, FEMALE: 6.4 (6.1-6.5) mm long, 2.5 (2.4-2.6) mm wide across eyes.

Material examined: Lectotype ♂, "Ceylon/ Peradeniya/ März 1902/leg. Dr. Uzel/ DR MELICHAR" and "Transcriptio/ *Goniagnathus* ♂/ *nervosus* n.sp./ L. Melichar det. 1903/P. Lauterer det. 1996" and "Lectotypus/ *Goniagnathus* ♂/ *nervosus*/ Melichar 1903/ P. Lauterer design. 1996" (MMB). Paralectotypes: 1♂, data as for lectotype, originally placed on the same block as lectotype, now separated and relabelled by Dr. P. Lauterer; 1♀, "Ceylon/ Peradeniya/ Juni 902/ leg. Dr. Uzel/ DR MELICHAR" and other data as in lectotype; 2 fifth instar nymphs, data as for lectotype (MMB).

Other material: INDIA: Karnataka: 1♂, 3♀, Jog Falls (534 m), 17-18.xi.1976, B. Mallik; 2♂, 1♀, Mudigere, 21.v.1975; 1♂, 3♀, 6.iv1980; 2♂, 3♀, 21-22.v.1976, C.A. Viraktamath and B Mallik; 1♂, Bangalore, 3.iv.1978, A.R.V. Kumar; 1♀, Biligirirangana Hills, 13.viii.1976, C.A. Viraktamath. Pondicherry: 2♂, Mahé, 15.ix.1979, A.R.V. Kumar. Maharashtra: Mahabaleshwar 1,381 m, 20.xi.1977, C.A. Viraktamath. Kerala: 2♂, Kottayam, 25.iii.1977, B. Mallik (UAS).

Remarks: This species is related to *G. concavus* sp. nov., but differs from it in having an unpaired ventral process to aedeagus and longer dorsal appendage to the pygophore.

Goniagnathus punctifer (Walker)
(Figs 38-44)

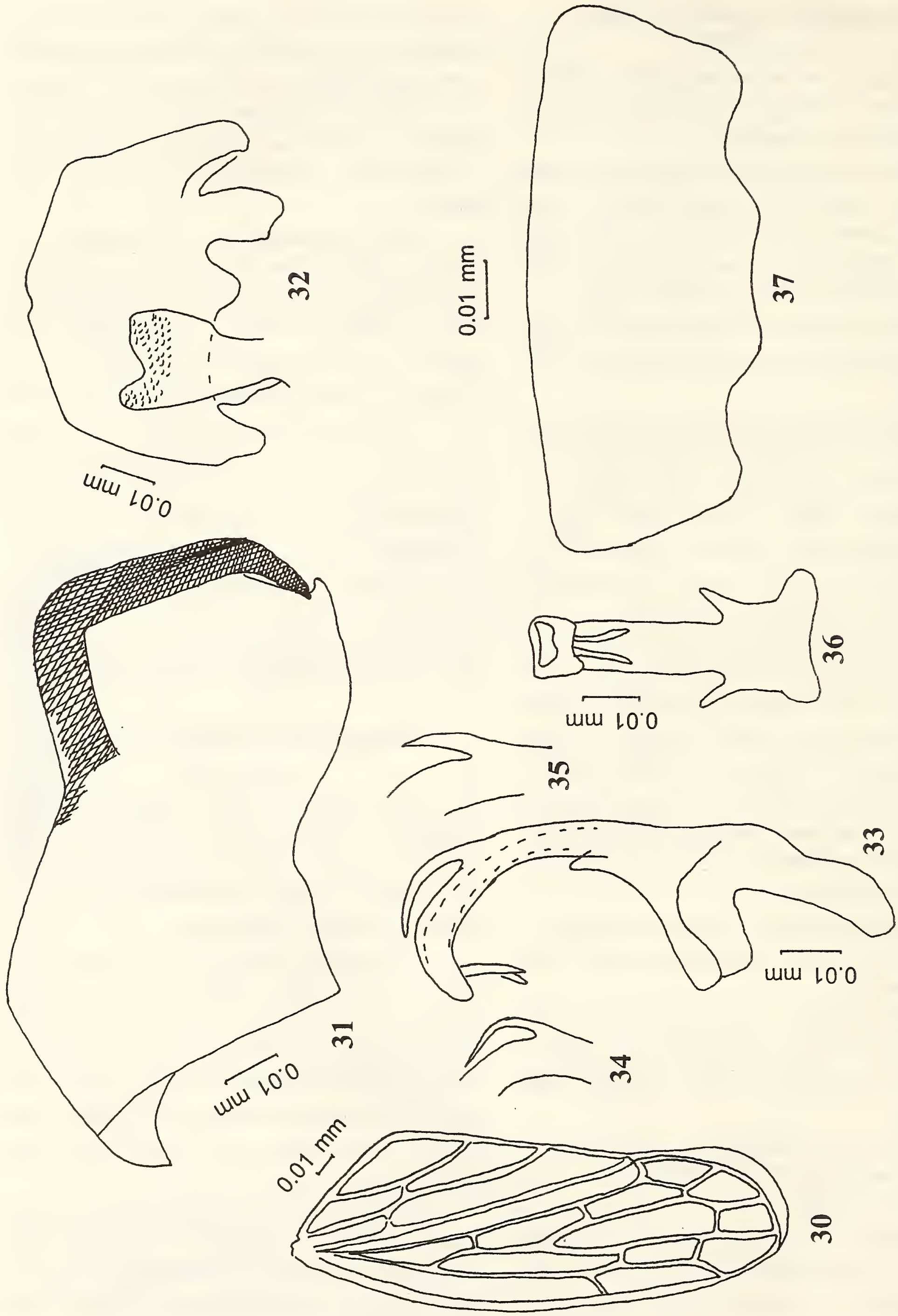
Bythoscopus punctifer Walker, 1858: 104. Lectotype ♂, India (BMNH, examined).

Goniagnathus spurcatus Melichar, 1903: 181. Lectotype ♂ designated here by P. Lauterer, Sri Lanka (MMB, examined).

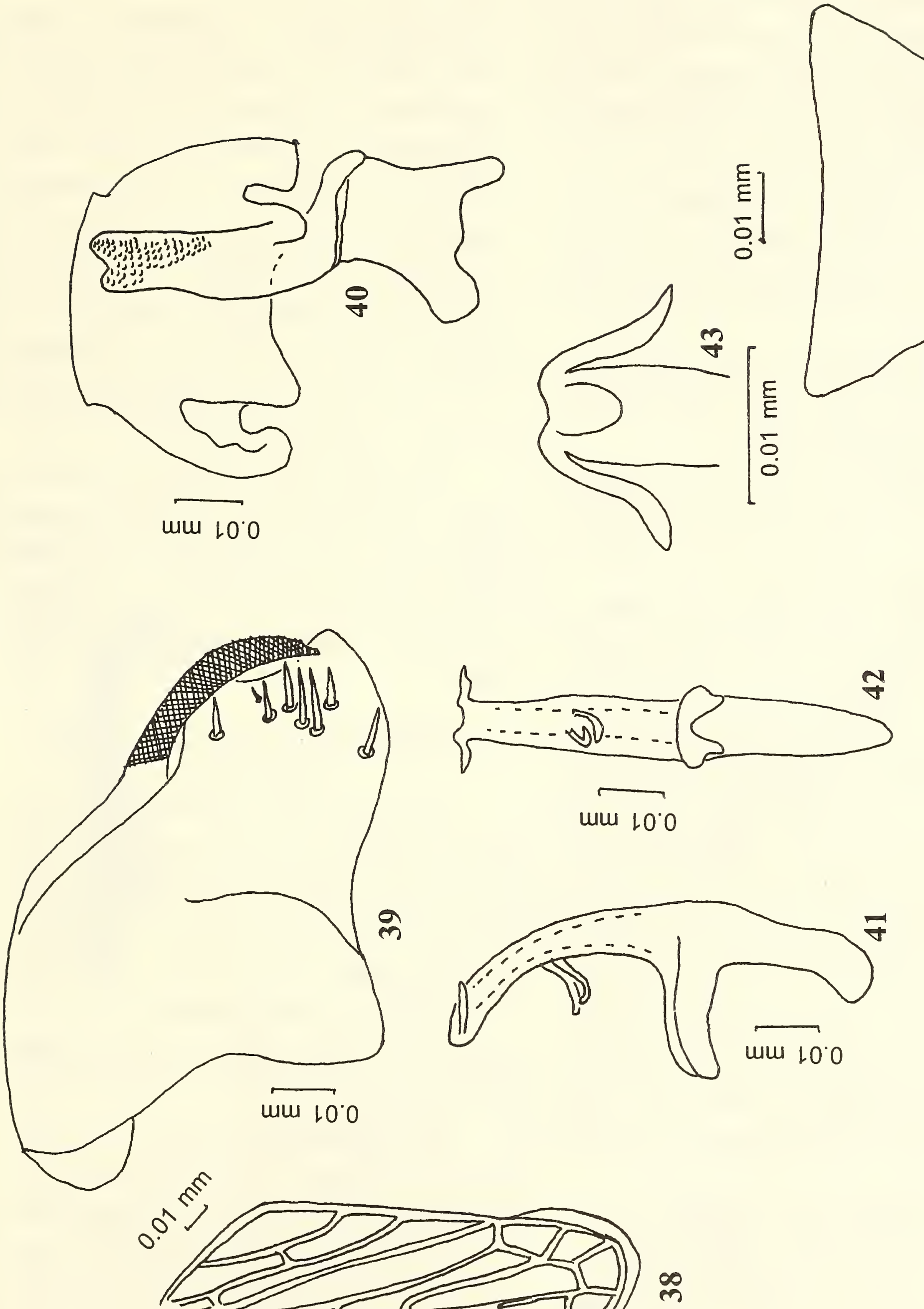
Coloration as described by Distant (1908) with the following additions: Ochraceous, irregular reddish-brown markings on vertex, pronotum and scutellum. Anterior margin of vertex yellow with faint brownish spots. Face with interrupted black fascia, eyes black with reddish-brown margin and stripes. Forewings ochraceous.

Vertex five times as wide as median length. Forewing with inner anteapical cell open behind.

Male genitalia: Pygophore caudally narrowed with an obtusely rounded caudal lobe having a few setae, dorsal appendage slender,



Figs 30-37: *Goniagnathus nervosus* Distant: 30. Forewing; 31. Male pygophore; 32. Fused subgenital plate and apex of style; 33. Fused connective and aedeagus, lateral view; 34, 35. Variations in the caudal process of aedeagus in lectotype and paralectotype; 36. Aedeagal shaft, cephalic view; 37. Female seventh sternum.



Figs 38-44: *Goniagnathus punctifer* (Walker): 38. Forewing; 39. Male pygophore; 40. Fused subgenital plate and style; 41. Fused connective and aedeagus, lateral view; 42. Fused connective and aedeagus, cephalic view; 43. Apex of aedeagal shaft; 44. Female seventh sternum.

black, not reaching caudo-ventral angle. Fused subgenital plate twice as broad as median length, narrowed caudally with truncate apex. Style with bilobed apophysis, outer lobe slightly longer than inner. Aedeagal shaft slightly curved, with an apical pair of laterally directed processes, and a median pair of slightly asymmetrically curved processes on cephalic margin at mid-length; gonopore large, apical; dorsal apodeme less than half as long as shaft, shorter than preatrial extension.

Female genitalia: Seventh sternum three times as wide as long, hind margin broadly produced with a median notch.

Measurements: MALE: 5.7 (5.1-6.4) mm long, 2.2 (2.1-2.4) mm wide across eyes. FEMALE: 5.9 (5.6-6.4) mm long, 2.4 (2.3-2.5) mm wide across eyes.

Material examined: Lectotype ♂, "*punctifer* Walk" "Ind." "68_4" here designated (BMNH). Lectotype ♂, "Ceylon VI/ Peradeniya (struck off)/ Colombo/ leg. Dr. Uzel/ DR MELICHAR" and "*spurcatus/* det. Melicha" and transcribed labels "Transcriptio/ *Goniagnathus*/ *spurcatus* sp. n./L. Melichar det. 1903/ P. Lauterer det 1996" and Lectotypus/ *Goniagnathus* ♂/ *spurcatus* Melichar 1903/ P. Lauterer design. 1996" and *Goniagnathus* ♂/ *punctifer*/ (Walker)/ P. Lauterer det. 1996" and Invent. C./ 3886/ Ent/ Mor. Museum, Brno" here designated by Dr. P. Lauterer (MMB). Paralectotype: 1♂, data as in lectotype, originally placed on the same block as lectotype, but now separated with inventory No. 3888/Ent, 1♀, data as for lectotype, but with inventory no. 3887/Ent. (MMB).

Other material: INDIA: Gujarat: 3♂, 1♀, Sasan-Gir, 31.i.1981, C.A. Viraktamath; 1♀, Ahwa, 17.i.1981, C.A. Viraktamath; 1♀, Waghai, 18.i.1981, C.A. Viraktamath. Maharashtra: 4♂, 2♀, Poona, 7.xi.1991, C.A. Viraktamath; 1♀, Dhond, 2.x.1981, A.R.V. Kumar. Mizoram: 1♂, Aizawl, 18.i.1981, C.S. Wesley. Karnataka: 1♂, Yellapur, 12.v.1982, C.A. Viraktamath; 1♂, Madhugiri, 6.vii.1980, A.R.V. Kumar; 1♀, Hiriyur, 13.viii.1978, C.A. Viraktamath; 2♀, Dharwar, 12.vii.1970, C.A. Viraktamath; 1♀, Sirguppa, 21.i.1982, A.R.V. Kumar; 1♂, 1♀, Mudigere, 6.iv.1980, Freidberg, 1♂, 21.v.1976, 3♂, 1♀, 8.i.1986, C.A. Viraktamath; 1♂, Gulbarga, 7.ix.1976, C.A. Viraktamath; 2♂, Raichur, 12.v.1992 and 24.vii.1992, S. Viraktamath. Kerala: 3♂, 1♀, 17 km E Trichur, 8.i.1986, C.A. Viraktamath. Meghalaya: 1♀, Nongpoh, 762 m, 4.xi.1981, C.A. Viraktamath. Mizoram: 1♂, Aizawl, 8.xi.1981, C.S. Wesley (UAS).

Remarks: This species is related to *G. appellans* and *G. fumosus*, but can be readily recognised by a pair of apical and a pair of rather asymmetrically curved processes arising at mid- length of the aedeagal shaft on dorsal aspect and the fused subgenital plates being square tipped.

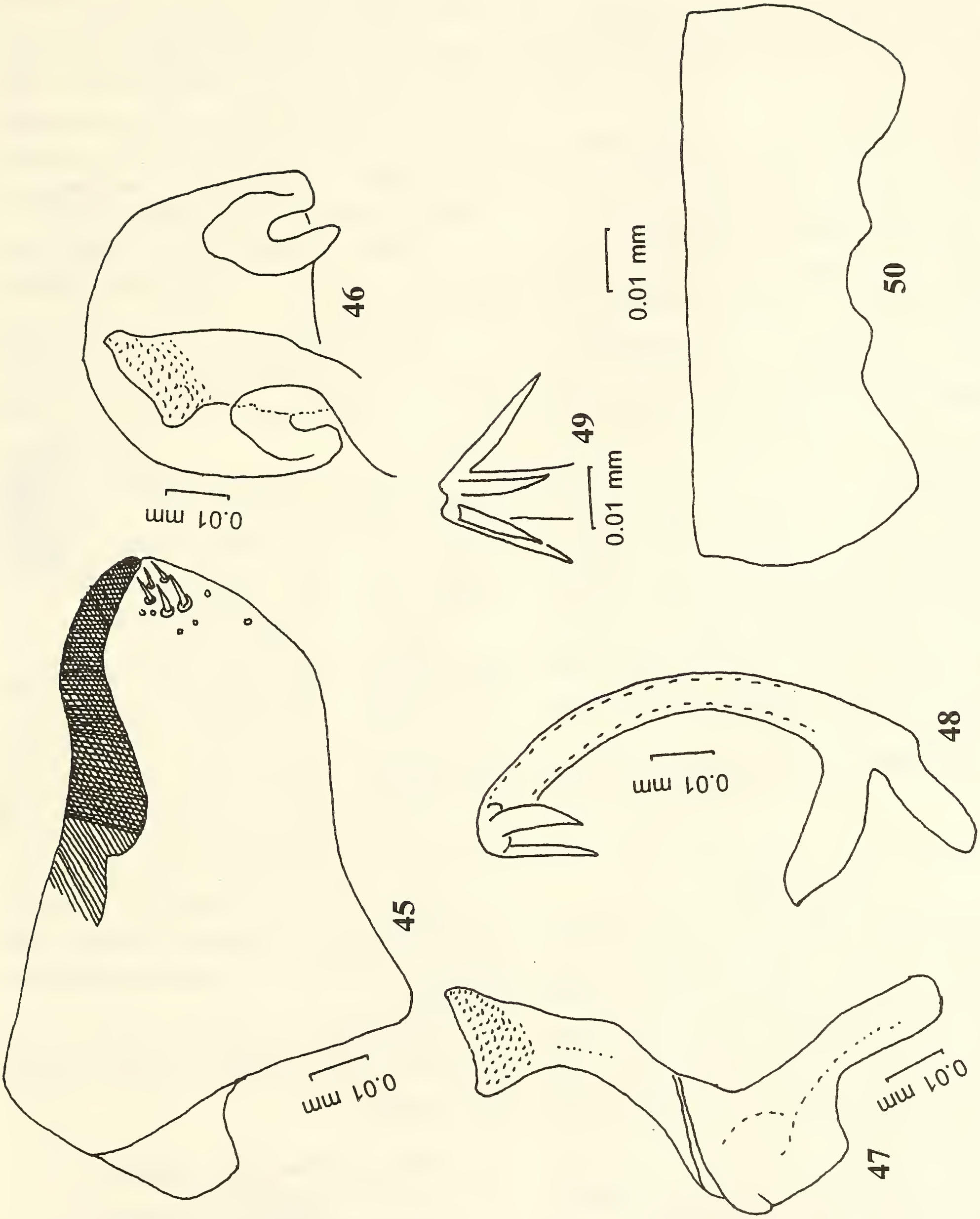
Goniagnathus quadripinnatus sp. nov.

(Figs 45-50)

Ochraceous, faint reddish-brown band on anterior margin of vertex between ocelli. Eyes with reddish margin and stripes. Irregular reddish-brown patches on vertex, pronotum and scutellum. Forewings ochraceous with distinct veins. Pronotum with four and scutellum with two longitudinal reddish stripes.

Vertex three times as wide as long. Forewing with inner anteapical cell closed behind by a cross vein.

Male genitalia: Pygophore elongate, caudally narrowed, dorsal appendage not exceeding caudo-dorsal angle. A few macrosetae at dorso-apical area. Fused subgenital plate broader than long, caudally convexly rounded. Apophysis of style bilobed, outer lobe shorter than inner, blunt. Aedeagal shaft tubular, curved dorso-anteriorly, with a pair of slender, elongate, apical and a pair of shorter, lateral, subapical



Figs 45-50: *Goniagnathus quadripinnatus* sp. nov.: 45. Male pygophore; 46. Fused subgenital plate and apex of style; 47. Style; 48. Fused connective and aedeagus, lateral view; 49. Apex of aedeagal shaft; 50. Female seventh sternum.

processes; gonopore large; dorsal apodeme 0.33 as long as shaft.

Female genitalia: Seventh sternum 3.3 times as wide as long, hind margin concave with obtusely rounded lateral margin and deeply notched in middle.

Measurements: MALE: 4.5 mm long, 1.9 mm wide across eyes. FEMALE: 5.1 (4.3-5.5) mm long and 2.2 (2.0-2.5) mm wide across eyes.

Material examined: Holotype ♂, INDIA: Karnataka: Chikballapur, 3.viii.1976, B. Mallik (UAS). Paratypes: 1♂, data as in holotype; 2♂, Bangalore, 21.i.1976, C.A. Viraktamath; 1♂, 7 km N Dodballapur, 18.vii.1977, C.A. Viraktamath; 1♂, Gulbarga, 20.viii.1981, A.R.V. Kumar; 1♂, 1♀, Dharwar, 25.vii.1972, C.A. Viraktamath; 1♂, 30.viii.1972, 1♂, 22.iv.1972, C.A. Viraktamath. Orissa: 2♂, Bhubaneswar, 13.vi.1993, P.C. Dash (BMNH, NPC, UAS).

Remarks: This species is very similar to *G. appellans* in the structure of male genitalia. However, it differs from *apellans* in having broader subgenital plate, dissimilar lobes of the apophysis of style and slender apical processes of the aedeagal shaft.

Etymology: *quadripinnatus* refers to the four apical processes of the aedeagus.

Goniagnathus symphysis sp. nov.

(Figs 51-58)

Ochraceous. Vertex with anterior margin yellowish, a black band touching ocelli, irregularly scattered minute reddish spots, coronal sulcus black. Eyes with ochraceous margin and reddish-brown stripes. Legs with irregular black markings. Forewing ochraceous with distinct greyish veins, claval, veins with irregular black spots.

Vertex 5.5 times as wide as long. Forewing with inner anteapical cell closed behind by a cross vein.

Male genitalia: Pygophore elongate, caudal lobe produced conically, dorsal appendage stout, black, a few setae on apical 0.33 of lobe. Fused subgenital plate broader at base than long, with caudal margin rounded. Apophysis of style deeply bilobed, outer lobe slender, more acutely pointed than inner lobe. Aedeagus short, stout, shaft constricted before apex and then broadened, dorsal apodeme 0.33 as long as shaft; gonopore large, round, margined by two sclerotized processes which do not meet apically.

Female genitalia: Seventh sternum width 2.7 times its length, hind margin strongly notched in middle.

Measurements: MALE: 5.6 (5.3-5.9) mm long, 2.35 (2.3-2.4) mm wide across eyes. FEMALE: 6.1 (5.7-6.7) mm long, 2.5 (2.4-2.6) mm wide across eyes.

Material examined: Holotype ♂, INDIA: Gujarat: Waghai, 18.i.1981, C.A. Viraktamath (UAS). Paratypes: 1♂, data as for holotype; INDIA: Gujarat: 2♂, 1♀, Waghai, 18.i.1981, S. Viraktamath (BMNH, NPC, UAS).

Other material: Maharashtra: 2♂, Igatpuri, 23.iv.1980. Tamil Nadu: 1♂, Yercaud, 18.ix.1978; 1♀, Shambaganur, 29.x.1975; 1♂, 3♀, 30.x.1975 all coll. C.A. Viraktamath. Karnataka: 1♂, Mudigere, 21.v.1975; 1♂, 1♀, 21.v.1976, B. Mallik; 1♂, Jog Falls, 18.xi.1976, B. Mallik; 2♂, Biligirirangan Hills, 13.viii.1977, 1♂, 9.viii.1977, coll. C.A. Viraktamath (UAS).

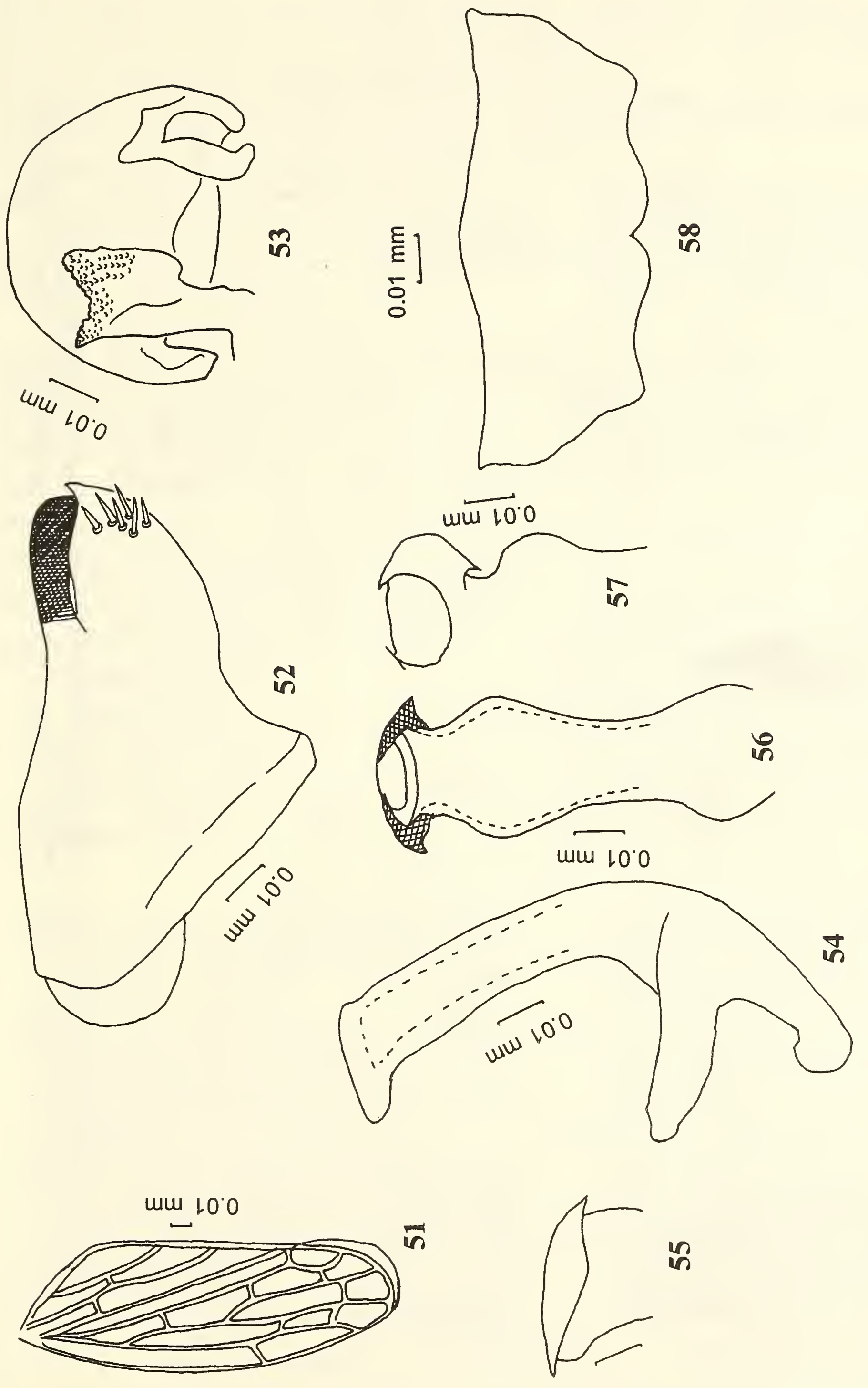
Remarks: This species can be easily distinguished by the absence of aedeagal shaft processes except for the marginal sclerotisation of gonopore.

Etymology: *symphysis* refers to two processes of the aedeagal shaft which appear glued together.

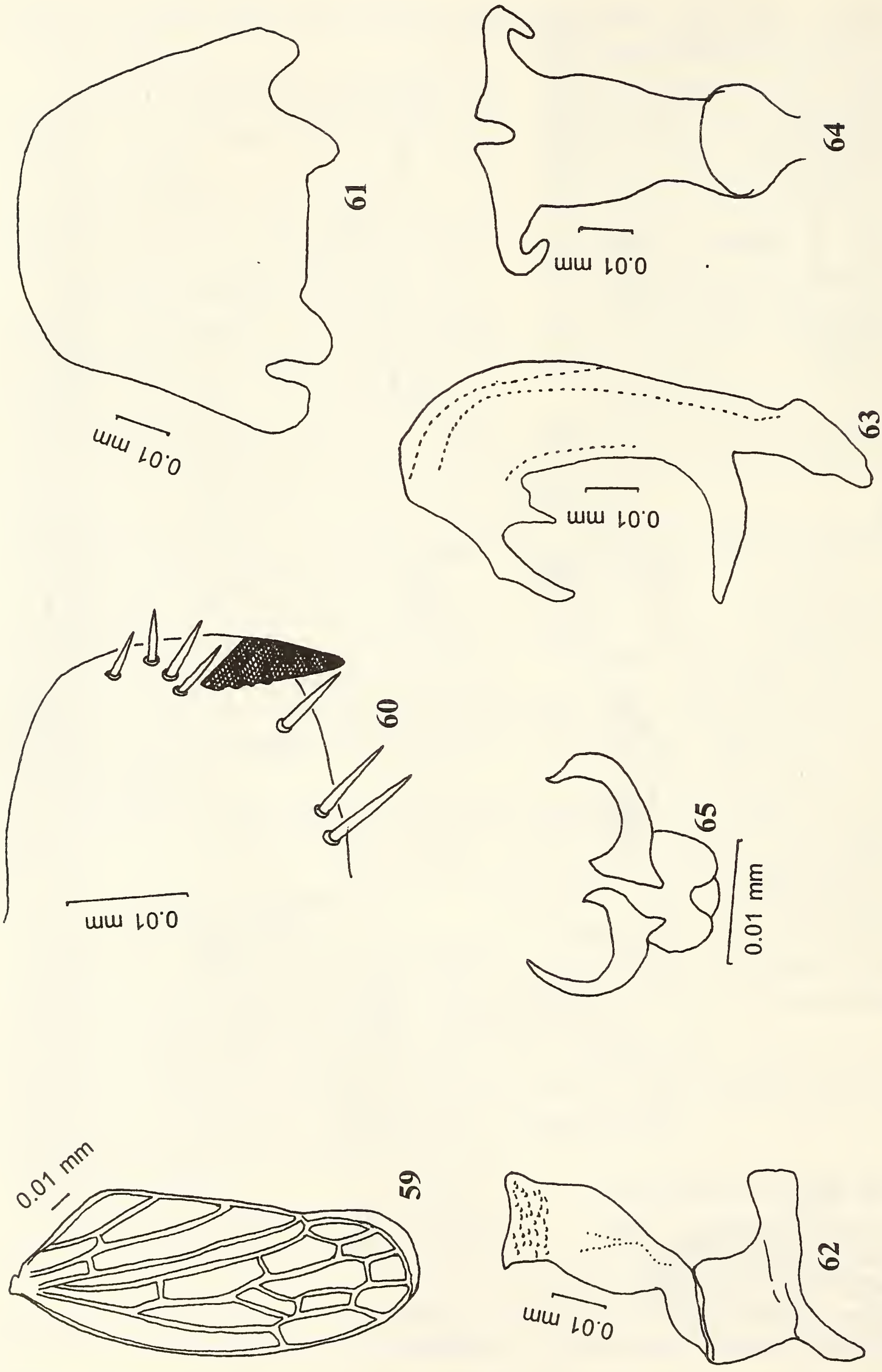
Goniagnathus syncerus sp. nov.

(Figs 59-65)

Coloration dark brown. Apical margin of head ivory with dorsal and ventral black transverse stripes. Face ochraceous with dark brown transverse stripes on fronto-clypeus. A few



Figs 51-58. *Goniagnathus symphysis* sp. nov.: 51. Forewing; 52. Male pygophore; 53. Fused subgenital plate and apex of style; 54. Fused connective and aedeagus, lateral view; 55. Apex of aedeagal shaft; 56, 57. Different views of aedeagal shaft; 58. Female seventh sternum. Scale line indicates 0.01 mm.



Figs 59-65: *Goniagnathus syncerus* sp. nov.: 59. Forewing; 60. Process of male pygophore; 61. Fused subgenital plate; 62. Style; 63. Fused connective and aedeagus, lateral view; 64. Fused connective and aedeagus, cephalic view; 65. Apex of aedeagal shaft.

spots or stripes on genae, lora and clypellus dark brown. Thoracic pleurites with large black patches. Lateral margin of pronotum ivory with submarginal black longitudinal stripes. Forewings mottled with dark brown and white along veins. Fore and middle tibiae transversely banded with dark brown.

Vertex 4.5 times as wide as long. Forewing with inner anteapical cell closed behind by a cross vein, outer anteapical cell divided.

Male genitalia: Pygophore caudally truncate without dorsal appendage, with an oblique row of short bristles along caudo-dorsal margin, caudo-ventral angle with a short process. Fused subgenital plate broader basally, with caudal margin medially notched. Caudal margin of apophysis of style, slightly concave. Aedeagal shaft narrow at base, broadest at apical 0.66, with a pair of subapical, black, laterally curved processes, each process with a short basal tooth, dorsal apodeme half as long as shaft.

Female: Unknown.

Measurements: MALE: 5.3 mm long, 2.3 mm wide across eyes.

Material examined: Holotype ♂, INDIA: Rajasthan: Mt. Abu, 1,200 m, 24.i.1981, C.A. Viraktamath (UAS).

Remarks: This species can be readily recognised by the distally widened aedeagal shaft.

Etymology: *syncerus* refers to the two horn-like aedeagal processes which are together.

Goniagnathus bicolor Distant

Goniagnathus bicolor Distant, 1918: 43. Lectotype ♀, India (BMNH, examined).

Material examined: Lectotype ♀, "Calcutta" "Distant Coll. 1911-383" "*Goniagnathus bicolor* Distant. Type" here designated (BMNH).

Remarks: Judging from the structure of female seventh sternum, this species may prove to be a synonym of *G. fumosus*.

ACKNOWLEDGEMENTS

Dr. M.D. Webb (BMNH) provided information on the type series of the species described by W.L. Distant. Dr Pavel Lauterer (MMB) designated the lectotypes for species described by Dr. L. Melichar on our request and compared some of the illustrations of the species sent to him with the type series of *Goniagnathus* under his care.

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■ ■ ■

GARRA PERIYARENSIS, A NEW CYPRINID FISH FROM PERIYAR TIGER RESERVE, KERALA, INDIA[1]

K.C. Gopi[2]

(*With four text-figures*)

Key words: *Garra periyarensis* sp. nov., cyprinid fish, Periyar, Kerala

A new cyprinid fish, namely *Garra periyarensis*, from the headwaters of the Periyar river in the Periyar Tiger Reserve, Kerala, South India, is described. It is characterised by 37-39 scales on the lateral line, naked breast and belly, snout with a prominent tuberculated knob-like protuberance (antero-rostral lobe) differentiated from the tip of snout and 3-4 + 12-13 gillrakers on the first arch.

Introduction

The genus *Garra* Hamilton-Buchanan, of the Subfamily *Garrinae*, according to Talwar and Jhingran (1991), is represented by 21 species in the Indian subcontinent, including *Garra menoni* Rema Devi and Indra, 1986, described from Silent Valley, Kerala, India, synonymised by them (without any discussion) with *Garra mullya* (Sykes) and *Garra kalakadensis* Rema Devi, described subsequently from Kalakad Wildlife Sanctuary, Tirunelveli district, Tamil Nadu (Rema Devi, 1992). *Garra menoni* has recently been treated as a valid species (Easa and Chand Basha 1995, and Easa and Shaji 1997). Shaji *et al.* (1997) have described *Garra surendranathanii* from Chalakudy, Periyar and Pamba river systems of Kerala, treating *Garra menoni* as a valid species. Thus, six species of *Garra* are so far known to occur in Kerala. They are *Garra mullya* (Sykes), *G. gotyla stenorhynchus* (Jerdon), *G. hughi* Silas, *G. mcclellandi* (Jerdon), *G. menoni* Rema Devi and Indra, and *G. surendranathanii* Shaji, Arun and Easa. Except for *Garra hughi* and *Garra menoni*, these species are already reported from the drainage system associated with the Periyar Tiger Reserve (Zacharias *et al.* 1996, Arun *et al.* 1996).

During a faunistic survey of the watershed areas of Periyar river within the Periyar Tiger Reserve, Kerala, India, two specimens of *Garra* were obtained, which appeared to be distinct from all the earlier known species of the genus. It is described here as a new species.

Material and Methods

The material examined were two specimens measuring 124.5 mm and 156.0 mm SL, collected by castnet from the Periyar river at Thanikkudy in the Periyar Tiger Reserve. Measurements were taken by dial calipers with an accuracy of 0.1 mm. Data are presented as percentages, with the range followed by the mean in parentheses.

Garra periyarensis sp. nov.
(Figs 1-4)

Diagnosis: A species of *Garra* having elongate and slender body with 37-39 scales on lateral line; breast and belly naked; a prominent, tuberculated, knob-like protuberance (antero-rostral lobe) on snout; 3-4 + 12-13 gillrakers on the first arch.

Holotype: ZSI, CLT (Zoological Survey of India, Calicut) No. V/F. 9426; 156.0 mm SL; Periyar river, Thanikkudy, Periyar Tiger Reserve, Kerala State, India; coll. P.M. Sureshan, 7.xi.1996.

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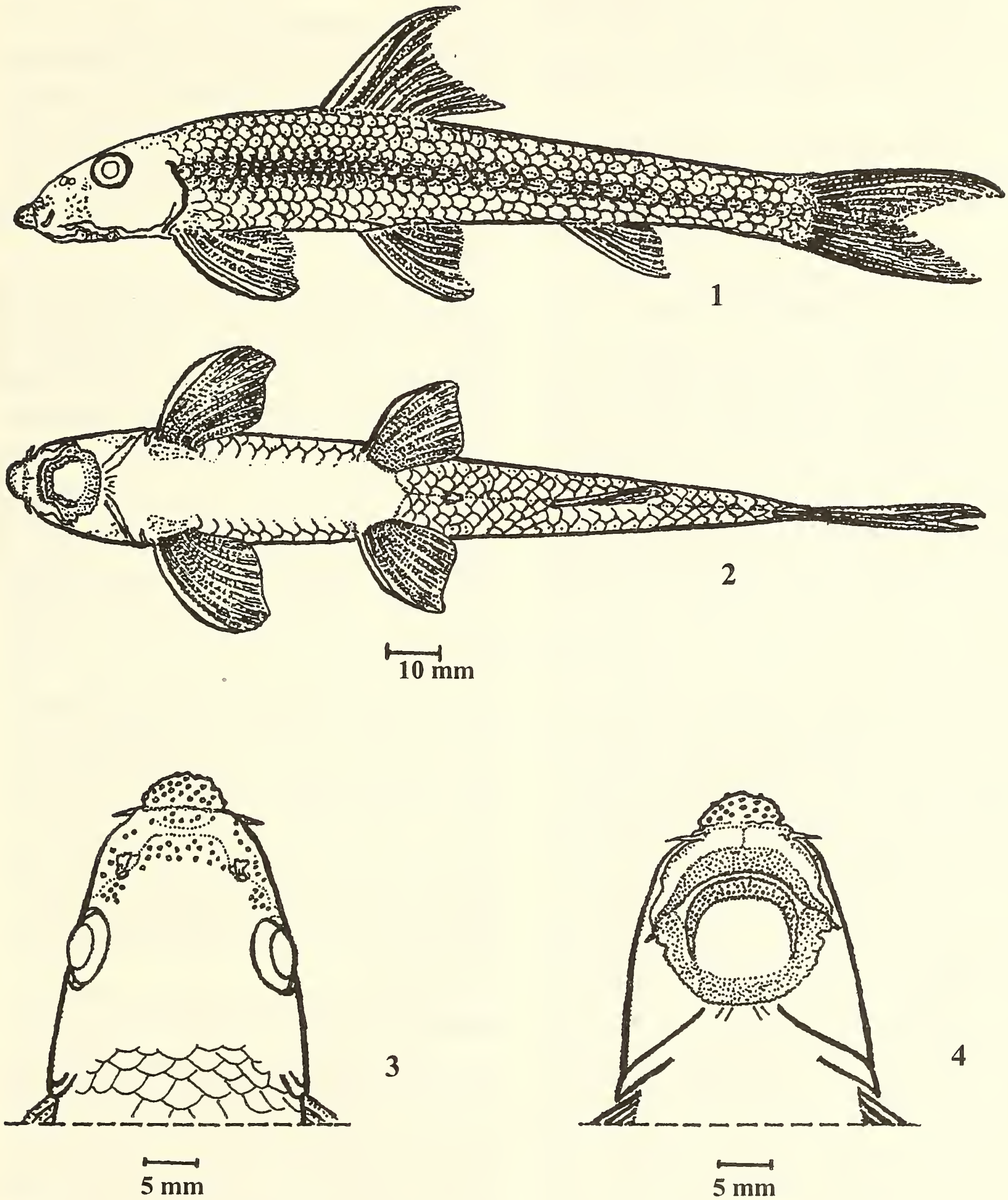

Figs 1-4: *Garra periyarensis* sp. nov.
1. Lateral view; 2. Ventral view; 3. Head: Dorsal view; 4. Head: Ventral view.

Paratype: One specimen, ZSI, CLT No. V/ F. 9427, 124.5 mm SL; same data as of holotype.

Description: Based on these two specimens (holotype and paratype),

D. 2/8, A. 2/5, P. 1/14, V. 1/7, L.l. 37-39, L tr. 5/1/4-5,

Predorsal scales: 10-11, Gillrakers: 3-4 + 12-13.

Body elongate and slender, dorsal profile gently rising anteriorly up to the origin of dorsal fin, and thereafter sloping straight to caudal base; ventral profile almost straight. Depth of body 17.67-17.76 (M=17.72)% SL, length of head 21.41-23.21 (M=22.31)% SL, width of head 65.40-70.96 (M=68.18)% HL, height of head 57.79-58.68 (M=58.24)% HL. Snout obtusely rounded, tuberculated, tip marked off by a transverse groove and differentiated into a prominent, flexible and knob-like protuberance (antero-rostral lobe, Figs 1-4). Horny tubercles present on snout and cheek: small and underdeveloped, with scattered mucous pores on cheek in holotype (possibly female), but prominent and well-developed ones in paratype (possibly male). Length of snout including the lobe at tip 53.28-53.29 (M=53.29)% HL. Diameter of eye 22.49-23.05 (M=22.77)% HL and 60.19-61.6 (M=60.9)% interorbital width. Interoribtal region flat, its width 37.37-37.43 (M=37.4)% HL. Barbels two pairs, subequal, rostral shorter than eye and maxillary rudimentary. 3-4 + 12-13 gillrakers on the first arch. Length of mental disc 36.23-36.33 (M=36.28)% HL, width 65.82-66.67 (M=66.25)% width of head, length of disc 78.21-83.33 (M=80.77)% its own width. Abdomen slightly rounded, vent much anteriorly located away from the origin of anal fin, distance from vent to anal origin 42.89-46.58 (M=44.74)% interdistance between anterior origins of pelvic and anal fins.

Caudal peduncle length 18.27-19.12 (M=18.7)% SL, 82.35-85.33 (M=83.84%) HL, its least height 48.74-48.82 (M=49.28)% its own length.

Squamation: Tube bearing scales on lateral line 37-39, scales in transverse series from midline of back to abdomen 5/1/4-5 with 4.5 series from origin of dorsal to lateral line and 3-3.5 between lateral line and origin of ventral fin, predorsal scales 10-11, circumpeduncular scales 12, breast and belly naked (Fig. 2), post-pelvic region scaly.

Fins: Dorsal origin nearer to the tip of snout than to base of caudal, over 11th scale of lateral line, dorsal margin of fin concave, its height more than length of head, 105.99-106.29 (M=106.14)% HL, 22.69-24.66 (M=23.68)% SL. Pectoral and pelvic fins subequal, smaller than head, length of pectoral 83.23-83.74 (M=83.49)% HL, length of pelvic 80.24-80.28 (M=80.26)% HL. Pelvic origin under 14th or 15th scale of lateral line. Anal origin opposite 27th scale of lateral line. Caudal deeply forked, longer than head, 114.88-115.57 (M=115.23)% HL, lobes pointed, the upper lobe longer than the lower one. Distance from tip of snout to anterior origin of fins: predorsal distance 42.76-43.13 (M=42.95)% SL, prepelvic distance 44.36-46.75 (M=45.56)% SL. Distance between anterior origins of fins: Pectoro-pelvic distance 24.23-24.73 (M=24.48)% SL, pelvic-anal distance 25.86-27.96 (M=26.91)% SL, 48.35-50.23, (M=49.29)% in that between pelvic origin and caudal base.

Etymology: Name implies the Periyar river in which it occurs.

Coloration: In preserved state, upper half of body brownish-black, lower yellowish-brown, becoming yellowish-white beneath; an indistinct midlateral band from behind the gill-opening to the base of caudal fin; a faint black spot behind upper angle of gill-opening; dorsal and caudal fins dusky grey, and other fins lighter, shaded with yellowish-grey.

Distribution: Known so far only from the

Periyar drainage at Thanikkudy, Periyar Tiger Reserve, Kerala State, India.

Remarks: *Garra periyarensis* appears to be related to *Garra mcclellandi* (Jerdon), *Garra hughi* Silas and *Garra surendranathanii* Shaji, Arun and Easa with respect to the general characters, such as: more elongated body, higher count of scales on lateral line and more anteriorly located vent, away from the origin of anal fin. The new species, like the other three species, falls under the species-group '*yunnanensis* complex' of Menon (1964), which also has representatives in northeastern India, as far east as Yunnan, South China and Indo-China. The *yunnanensis* complex includes *Garra yunnanensis* (Regan) and *G. gracilis* (Pellegrin & Chevey) from China, *G. naganensis* Hora and *Garra kempi* Hora from Assam, India, and *G. mcclellandi* (Jerdon), *G. hughi* Silas and *G. surendranathanii* Shaji, Arun and Easa from the Western Ghats, India.

Garra periyarensis differs from all the above species in the following combination of characters: a prominent, tuberculated knob-like protuberance on snout and absence of scales on breast and belly. It can easily be separated from *G. mcclellandi,* its closest relative in the Western Ghats, by the absence of scales on the ventral side and in the greater number of gill rakers and lateral line scales.

Acknowledgements

I thank the Director, Zoological Survey of India, Calcutta and the Officer in charge, Western Ghats Field Research Station, Zoological Survey of India, Calicut, for encouragement and facilities. I also thank Dr. K. Rema Devi, Scientist, Zoological Survey of India, Chennai for going through the manuscript and for suggestions to improve it.

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■ ■ ■

ON A NEW SPECIES OF *HETEROGAMUS* WESMAEL (INSECTA: HYMENOPTERA : BRACONIDAE) FROM INDIA[1]

S.M. Kurhade[2] and P.K. Nikam[3]

(*With three text-figures*)

Key words: Hymenoptera, Braconidae, *Heterogamus* sp. nov.

Heterogamus rugosus sp. nov. is illustrated and described.

Introduction

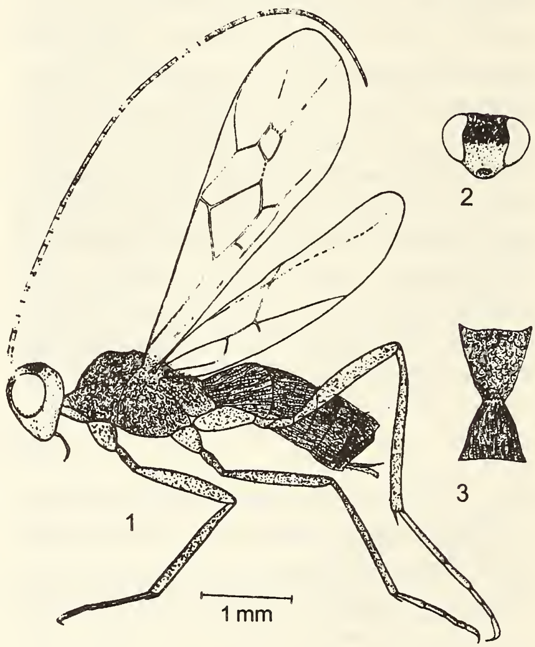
Wesmael (1838) erected the genus *Heterogamus* (Subfamily: Rogadinae), with *Aleiodes (Heterogamus) crypticornis* Wesmael as type species.

Only ten species of the genus *Heterogamus* are known worldwide (Shenefelt 1975), and only one species, *Heterogamus percurrens* (Lyle) = *Rhogas* (*Heterogamus) percurrens* Lyle (1921) is known from India.

A new species is described from material collected in Ahmednagar, Maharashtra, India.

The new taxon has been compared with the known Indian species, *Heterogamus percurrens* Lyle.

Types are deposited in the Entomological collection of Department of Zoology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.



Figs 1-3: *Heterogamus rugosus* sp. nov. female
1. Lateral view, 2. Head viewed from front,
3. Propodeum and first abdominal tergite

Heterogamus rugosus sp. nov.
(Figs 1-3)

Female: Length 4.4 mm (Fig.1). Head (Fig. 2) transverse, 1.6 x as wide as long; vertex shiny, rugosely, closely punctate, with pubescence; the distance between median ocellus and eye 0.5 x the interorbital distance; frons weakly rugose, closely punctate, with pubescence; face as wide as long, closely, shallowly punctate, with pubescence, slightly convex, medially elevated; clypeus small, convex, closely punctate, pubescent, as wide as long; antenna 2 + 42 segmented; scape 1.7 x as long as wide, closely punctate, with pubescence; pedicel as long as wide, finely, weakly punctate, with pubescence; antennal joint 1.6 x as long as wide; terminal segment conical, 1.6 x as long as wide; penultimate segment as long as terminal

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segment; malar space 2 x basal width of mandible, closely punctate, with pubescence; mandible unidentate, as long as own basal width; occipital carina present; temple as wide as length of the mandible, closely, shallowly punctate, pubescent; eye bare, 2.6 x as long as wide.

Thorax: 2.6 x as long as wide; pronotum rugosely, closely punctate, pubescent; mesoscutum shiny, rugosely, densely punctate, with pubescence; middle lobe without any groove; notauli not prominent; metanotum weakly rugose; scutellum densely punctate, with pubescence, convex; mesopleurum shiny, rugosely, densely punctate, pubescent; mesopleural furrow distinct, extending 0.6 x the length of mesopleurum; dorsal half of metapleurum rugosely, closely punctate, with pubescence, and ventral half closely punctate, with pubesence; propodeum (Fig. 3) rugosely, densely punctate, pubescent, weakly carinated. Hindleg coxa 2 x as long as wide, densely punctate, pubescent; trochanters I + II, 2.5 x as long as wide, closely punctate, pubescent; femur 5.6 x as long as wide, densely punctate, pubescent; tibia 1.3 x as long as femur, finely punctate, pubescent; tibial spur as long as width of tibia; tarsus 5-segmented, finely punctate, pubescent; basitarsus 0.4 x length of tibia. Forewing 4.2 x as long as broad; stigma 5.8 x as long as wide; metacarpus 1.3 x as long as stigma; second abscissa of radius 1.1 x as long as first abscissa; third abscissa of radius 4 x as long as first abscissa; three cubital cells present; second cubital cell with four unequal sides; cubitus 2.4 x as long as stigma, sclerotized throughout its length; medius 0.7 x as long as costa; basal 0.4 x length of medius; nervulus slightly inclivous, distad, 0.7 x the width of stigma; anal cell 22.5 x as long as wide; hind wing 5.3 x as long as broad; nervellus reclivous, basad, 0.3 x as long as submediella; basella 0.4 x as long as mediella, sclerotized; cubitella 0.9 x as long as mediella; subcostella 1.3 x as long as mediella; metacarpella as long as subcostella; post nervellus 0.3 x as long as nervellus, opposite.

Abdomen: Spindle shaped, 3.5 x as long as wide, without median keel; first tergite 1.1 x as long as wide, apically, strigosely, closely punctate, pubescent on dorsolateral side, mid-dorsally coriaceous, closely punctate, pubescent; third tergite 0.7 x its own width, strigosely densely punctate, with pubescence; fourth tergite as long as wide at base, strigose, densely punctate, pubescent on mid-dorsal side, closely punctate, pubescent on dorsolateral side; fifth tergite strigose, densely punctate, pubescent; ovipositor 1.4 x as long as width of coxa; ovipositor sheath as long as ovipositor, pubescent.

Yellowish-brown. Tip of mandibles brownish-black; veins, basal 0.6 of first tergite, mid-dorsolateral area of second tergite, mid-dorsal area of third and fourth tergites dark brown; ovipositor sheath blackish.

Male: Unknown.

Host: Unknown.

Holotype: Female: INDIA: Maharashtra: Ahmednagar, 15.viii.1989, Malaise trap, coll. S.M. Kurhade; antenna, wings and legs mounted on slides and labelled as above.

Paratypes: 22 females, data same as holotype except 10 females collected on 29.viii.1989

Discussion

The new species *Heterogamus rugosus* superficially resembles the only known species of the Indo-Australian region from India, namely *Heterogamus percurrens* Lyle (1921). The new taxon differs in having (i) mesoscutum shiny, rugosely, densely punctate (in *H. percurrens* mesonotum with a broad, longitudinal, faintly infuscated band inside each notaulus, and two narrow short ones on the mid lobe anteriorly), (ii) metanotum weakly rugose (in *H. percurrens* metanotum smooth), (iii) antennal joint 1.6 x

as long as wide (in *H. percurrens* about one third longer than broad), (iv) propodeum rugosely, densely punctate, pubescent, weakly carinated (in *H. percurrens* irregularly rugulose, with a median keel not percurrent), (v) stigma 5.8 x as long as wide, (vi) abdomen without median keel (in *H. percurrens* abdomen with the median keel), (vii) tergites1-4 strigosely punctate and (viii) body length 4.4 mm (in *H. percurrens* body length just over 5 mm).

Acknowledgements

We thank the former Head of the Department of Zoology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad for laboratory facilities. The first author thanks the Principal, New Arts, Commerce and Science College, Ahmednagar for permission to carry out this work at Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.

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* Original not referred.

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TWO NEW SPECIES *OF BULBOPHYLLUM* THOUARS (ORCHIDACEAE) FROM SOUTHERN WESTERN GHATS, INDIA[1]

Muktesh Kumar and Stephen Sequiera[2]

(*With two text-figures*)

Key words: New species, *Bulbophyllum*, Southern Western Ghats, Kerala, India.

Two new species from Kerala, India, namely *Bulbophyllum keralensis* and *Bulbophyllum josephi* are described and illustrated.

Introduction

The genus *Bulbophyllum* Thou. is included in the subtribe Bulbophyllinae of the tribe Dendrobiae, Subfamily Epidendroideae, which forms one of the largest and most important groups of Orchidaceae (Misra 1997). This is perhaps the largest genus in the Orchid family, with about 1000 species distributed throughout tropical Africa and Asia, extending to Australia, New Zealand, Japan and Korea (Santapau and Kapadia 1966; Seidenfaden 1973, 1979; Abraham and Vatsala 1981). The separation of the genus *Cirrhopetalum* Lindl. is still controversial, since the flowers of *Cirrhopetalum* and *Bulbophyllum* show similarity in fundamental characters. Recently, Garay *et al.* (1994) revised the genus *Cirrhopetalum* and *Bulbophyllum* alliance and reinstated *Cirrhopetalum* as a separate genus.

From the Indian phytogeographic regions, 98 species and 2 varieties of the genus *Bulbophyllum* are known to occur among which 12 species have been recorded from Kerala. During the survey on the epiphytic flora of the Western Ghats, the authors collected two interesting species of *Bulbophyllum* from the forests of Kerala. On critical examination these species are found to be new to the orchid flora, and are described and illustrated here.

Bulbophyllum keralensis
Muktesh & Stephen sp. nov.
(Fig. 1)

Bulbophyllum macraei affinis, sed in laminis ellipticis emarginatis, sepalo dorsali papillato, sepalis lateralibus liberis lineari-ovatis subulatis induplicatis papillatis, petalis ellipticis cuspidatis papillatis, stelidiis minutis 1.2 mm longis differt.

Typus: INDIA: Kerala, Palghat district, Silent Valley National Park, Sispara, 1,800 m, *Stephen 007857 KFRI;* (Holotypus KFRI).

In general appearance this species resembles *Bulbophyllum macraei* (Lindl. Reichb. f.) (Jayaweera, 1981), but it differs in having elliptic, emarginate lamina; papillate dorsal sepal; linear-ovate, subulate, induplicate, papillate, free lateral sepals; elliptic, cuspidate, papillate petals and minute, 1.2 mm long stelidia.

Epiphytic pseudobulbous creeping herbs; pseudobulbs 1.2-2 x 0.5-0.7 cm, ovoid, angled. Leaves petiolate, solitary, at the top of pseudobulb, lamina 1.8-6 x 0.8-2 cm, elliptic, emarginate, grooved along midrib, coriaceous. Inflorescence umbel or sub-umbel, peduncle 10-12 cm, with 3 linear sterile bracts; floral bracts

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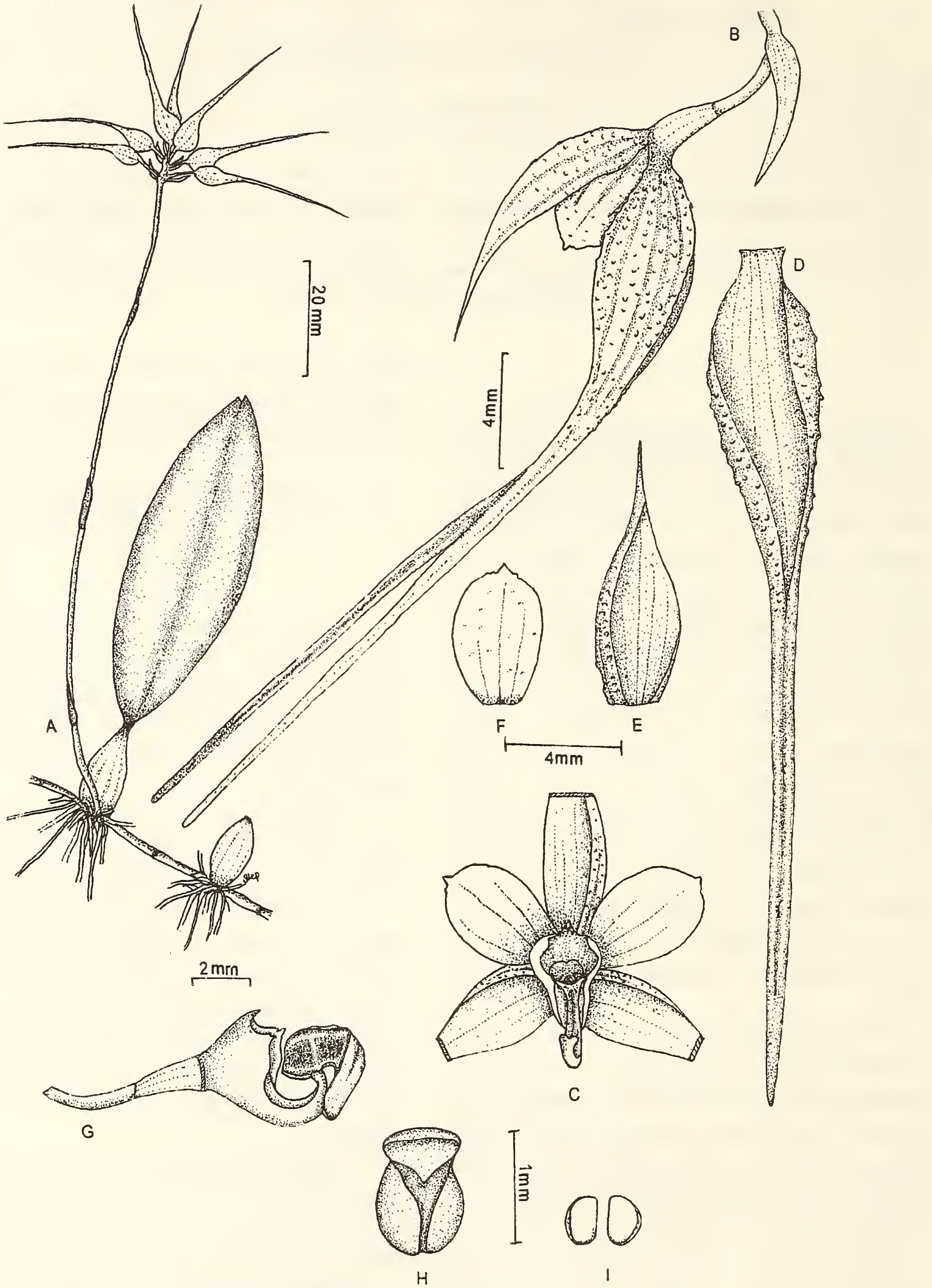

Fig. 1: *Bulbophyllum keralensis* Muktesh & Stephen sp. nov.
A – Habit; B – Single flower with floral bract; C – Flower front view; D – Lateral sepal; E – Dorsal sepal; F – Petal; G – Column with lip; H – Operculum; I – Pollinia.

4-6 x 1-1.2 mm, ovate, acuminate; flowers 4-7, golden yellow with purple tinge, 28-32 x 5-7 mm; sepals dissimilar, dorsal sepals 7-9 mm long, 3.2-3.4 mm at the broadest point, ovate-lanceolate, acuminate, induplicate, papillate at the base, 5-veined; lateral sepals 27-30 mm long, 2.3-2.6 mm broad, parallel, linear-ovate, subulate, 5-veined, free, induplicate, papillate; petals 4-6 x 2-3 mm, elliptic, slightly falcate, 3-veined, cuspidate, entire, slightly papillate; lip 4.6 x 1.2 mm, recurved, tongue shaped, obtuse, pouched, attached to the column foot; column 2.8 x 2 mm, broadly ovate; stelidia minute, 0.2 mm long; anther terminal; pollinia 4 in pairs, 0.4 x 0.25 mm; oval shaped; operculum 1 x 0.75 mm, broadly obovate.

Ecology: Epiphytic on moss covered tree trunks in the evergreen shola forests from 1,800 to 2,000 m.

Distribution: So far known only from Kerala – Silent Valley National Park (Palghat) and Wynaad

Fl. and Fr.: August-September.

Other specimen examined: Kerala, Wynaad District, Pakshipadalam, 1,200 m, *Stephen & Michael 008140 KFRI*

Etymology: Named after the state of Kerala, where it was collected.

Bulbophyllum josephi
Muktesh & Stephen sp.nov.
(Fig. 2)

Bulbophylum elegantulum et *B. acutiflorum* affinis sed in scapo 4-4.5 cm longo folio breviore, sepalo dorsali ovato-lanceolato acuminato induplicato, papillis dispersis, sepalis lateralibus oblongo-lanceolatis acutis papillatis, marginibus apice versus connatis, petalis oblongo-ovatis falcatis, apice apiculato, stelidiis longis angustis differt.

Typus: INDIA: Kerala, Palghat district, Silent Valley National Park, Punnamala, 850 m. *Stephen 007521 KFRI* (Holotypus – KFRI).

Allied to *Bulbophyllum elegantulum* (Rolfe) J.J. Sm. and *Bulbophyllum acutiflorum* A. Rich., but differs in having 4-4.5 cm long scape which is shorter than the leaf; ovate-lanceolate, acuminate, induplicate, dorsal sepal with scattered papillae, oblong-lanceolate, acute, papillate lateral sepals which are connate at upper edges, oblong-ovate, falcate petals with apiculate apex and long narrow stelidia.

Epiphytic pseudobulbous, creeping herbs; pseudobulbs 1-1.3 x 0.6-1 cm, ovoid; leaves solitary at the tip of the pseudo-bulb, lamina 3.7-4.1 x 0.8-1.2 cm, elliptic, emarginate, grooved along midrib, coriaceous; inflorescence umbel or sub-umbel, peduncle up to 5 cm with 1 or 2 sterile bracts; floral bracts minute, 3 mm long, ovate, acuminate; flowers yellow with violet specks, 10 x 3.5 cm, pedicel up to 6 mm long; sepals dissimilar, dorsal sepal 4.5 mm long, 1.5 mm broad; ovate-lanceolate, acuminate, induplicate, scattered papillae at the base, 5-veined; lateral sepals 9.5-10 cm long, 3 mm broad, oblong-lanceolate, acute, papillate; connate at upper edges; 5-veined; petals 3 x 1.6 mm, oblong-ovate, slightly falcate, apex apiculate, 3-veined, speckled with violet, lip tongue shaped, 2.8 mm long, recurved, attached to the column foot; column 1.5 x 1.5 mm, orbicular ovate; stelidia 0.7 mm long, anther terminal; pollinia 0.3 x 0.1 mm; operculum ovate orbicular; 0.5 x 0.4 mm.

Ecology: Epiphytic on tree trunks in evergreen forests at 900-1,000 m.

Distribution: Known so far only from the type locality.

Fl. & Fr.: August-September.

Etymology: Named after Dr. J. Joseph, Former Joint Director, Botanical Survey of India, for his valuable contribution to the systematics of Indian orchids.

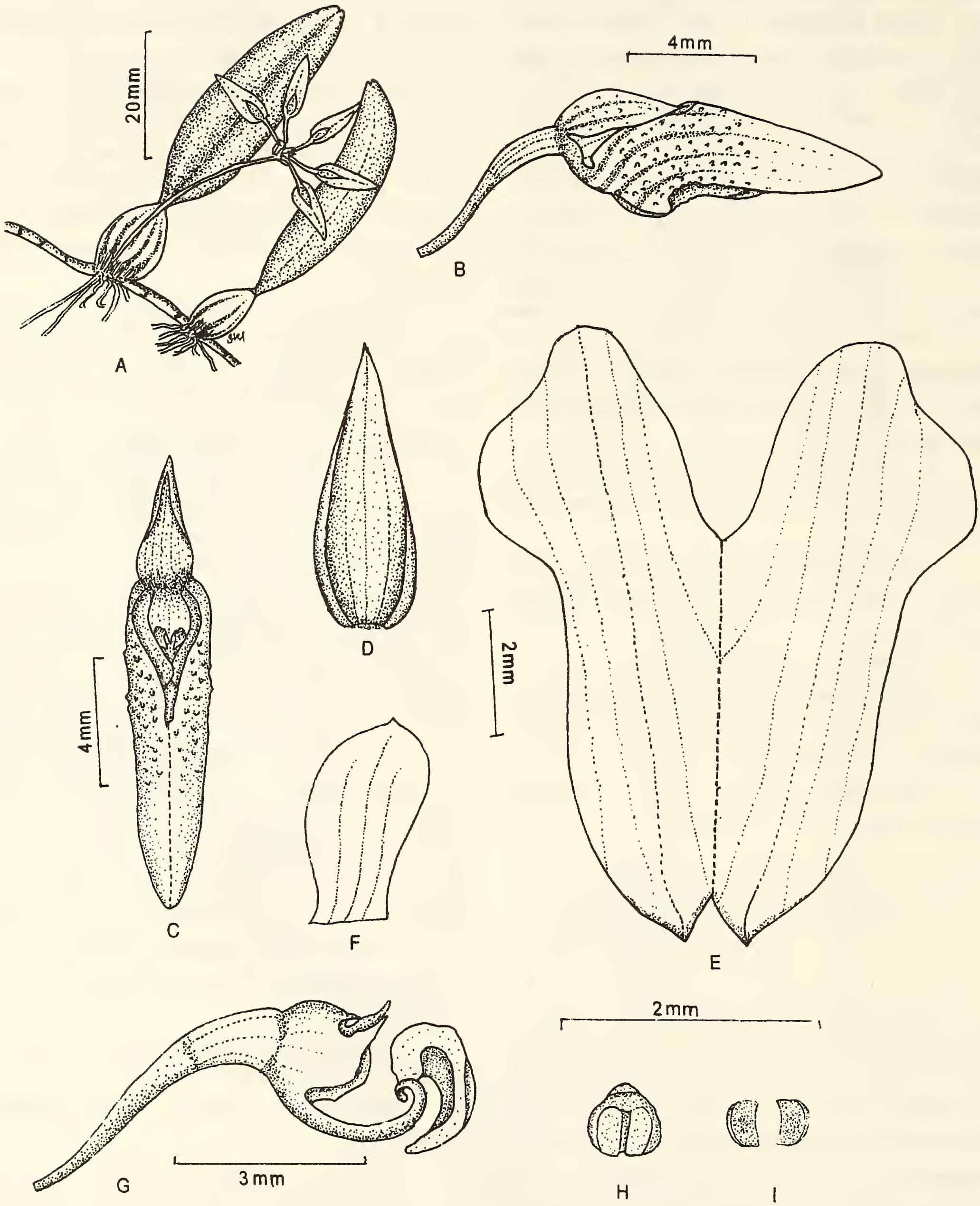

Fig. 2: *Bulbophyllum josephi* Muktesh & Stephen sp. nov.
A – Habit; B – Single flower; C – Flower top view (dorsal sepal lifted); D – Dorsal sepal; E – Lateral sepals; F – Petal; G – Column with lip; H – Operculum; I – Pollinia.

Acknowledgements

We thank Dr. K.S.S. Nair, Director, KFRI, for facilities and encouragement, the Chief Conservator of Forests (WL), Kerala Forest Department, for financial support and other facilities. We also thank Dr. Je F. Veldkamp, Leiden University, The Netherlands, for the Latin diagnoses.

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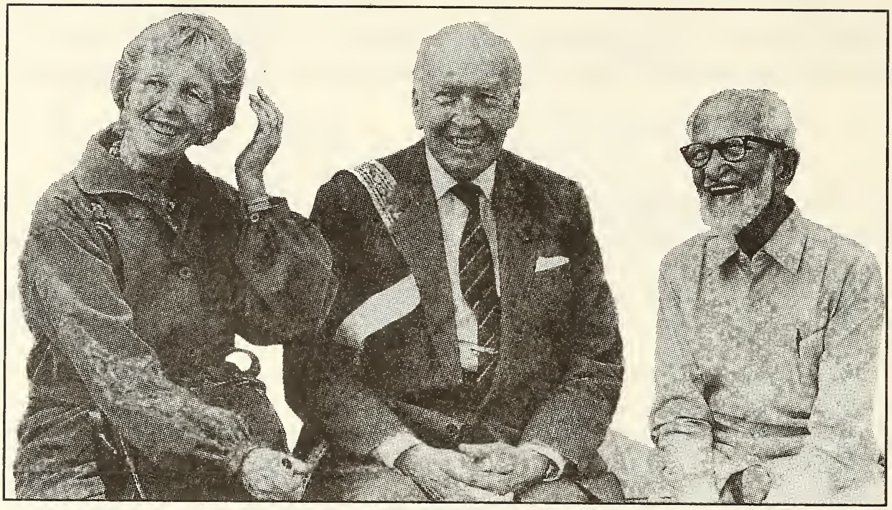
OBITUARY

Sidney Dillon Ripley II 1913-2001



L-R: Mary Livingston Ripley, S.D. Ripley and Dr. Sálim Ali in happier times

Ornithology of the Indian sub-continent has been dominated by personalities who were, in some way or other, giants of their own age out exploring the frontiers of the Empire. What started with A.O. Hume, that veritable politico-natural chronicler of a bygone era when style and elegance marked the distinctive individual stamp of the writer, has gradually evolved into the current crop of glossy pocket guides lacking in elegance and descriptive style.

Somewhere along the period not too long lost in our memory, and yet contemporary enough to relate to our own era, Sidney Dillon Ripley II, a rank outsider to the Raj legacy, teamed up with an Indian, Sálim Ali to give the region's most comprehensive ornithological tome. The Ali & Ripley duo straddled a transitional era when the ornithology of the region was being replaced from an enjoyably descriptive, delightfully rendered and immensely readable, though lengthy style to a spate of eco-statistical statements rendered in clinically scientific tomes on the one hand and quick-fix, over illustrated field guides with a bare minimum rendering in a telegraphic language on the other. And now the era of the last of the giants seems have come to an end in the passing away of Ripley in Washington on March 12, 2001.

Ripley, born in New York on September 20, 1913, had an early exposure to natural history. His grandfather, Sidney Dillon, the first Board Chairman of the American Union Pacific Railroad, way back in the 1870s had acquired a 2,000 acre land in Litchfield, Connecticut, where the boy Ripley grew up to study nature. This early exposure later shaped his interest and career in ornithology. Soon after his graduation, his spirit of adventure enabled him to travel east on a year-and-a-half long expedition to New Guinea and Borneo studying and collecting zoological specimens. He obtained his doctorate in zoology from Harvard University and joined as an assistant curator of birds in the Smithsonian Institution where later he was to become the Secretary.

His association with the Indian subcontinent began with a short stint in the Allied Intelligence Unit based in then Ceylon during World War II. This opportunity enabled him to study the birds of not only the Indian subcontinent, but also of Thailand, Burma and China. It also brought him two close future companions — his wife Mary Livingston, a colleague in the services, and Sálim Ali, both of whom he eventually outlived.

Ripley's most productive years were to follow soon after his assuming the post of Professor of Zoology and the Director of Peabody Museum at Yale University. Most of his scholarly writings in natural history and ornithology, as well as the initial foundation for the long association with Sálim Ali to write the ten-volume magnum opus THE HANDBOOK OF THE BIRDS OF INDIA AND PAKISTAN were done in this period. Ripley's name was already familiar to Indian ornithology through his A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN, published by the Bombay Natural History Society (BNHS) in 1961, and revised in 1982.

His golden years were during his tenure as the Secretary of the prestigious Smithsonian Institution, Washington, a post he discharged admirably till his retirement in September 1984. Under his vision and leadership many an innovation was brought in the museum concept and the Smithsonian scaled the heights in Science, Technology, Culture, Arts and American history. For his contribution to American folk history Ripley was awarded the Presidential Medal of Freedom, the highest civilian honour of the United States in 1985.

Ripley's close association with BNHS goes back to the time he was posted in Sri Lanka in the forties. His frequent official trips to India enabled him to spend time studying bird specimens in the BNHS collection and visit friend Sálim Ali, an association which was to blossom in later years into a long lasting research collaboration between BNHS and the Smithsonian Institution. Ripley was instrumental in channeling Smithsonian funds to continue the BNHS/WHO Bird Migration studies, which enabled the Society to not only collect data, but also to encourage and train young Indian biologists in bird studies. He helped finance and take active part with Sálim Ali in the field in joint ornithological expeditions to Simlipal, Orissa, Melghat, Maharashtra, Arunachal Pradesh and Bhutan Himalayas. These expeditions provided field data and helped both Ripley and Sálim Ali to gather material for the HANDBOOK, apart from obtaining valuable museum specimens.

Ripley was literally a "towering" personality, with matching intellect, scholarship, wisdom, grace and a delightful sense of humour. As the Secretary of the Smithsonian Institution he was constantly busy fulfilling his mandate and in the process, inevitably, he developed a reputation of being rather unapproachable, particularly to his staff and casual visitors. Being a fast track perfectionist himself, perhaps he was sometimes impatient with those who could not keep pace with him.

It was, however, a different story altogether when he was out on field trips in the Indian subcontinent. He was friendly and kind to the team members and always looked after their welfare. He didn't spare himself any hard work and always toiled along with the others on manual chores — whether it was pitching tents, packing, carrying and loading enormous expedition luggage, or walking miles to collect specimens and finally skinning and preserving them. After a hard day's work, it was always a treat to listen to the conversation between Ripley and Sálim Ali under lamp-lit tents. The subjects covered would be varied and Ripley would regale the audience from a fascinating repertoire, laced with humour and excitement in equal measure.

It is indeed sad that the era of personalities seems to have ended and Ripley was perhaps one of the last of the giants in Indian ornithology. For his three daughters, Julia, Rosemary, Sylvia and 11 grandchildren, as well as a number of young ornithologists who had the good fortune to have known him closely, Sidney Dillon Ripley II will always be a pleasant memory — a Man for all Seasons.

S.A. HUSSAIN

REVIEWS

1. CHECKLIST OF INDIAN MAMMALS by Nameer P. Ommer. Published by Kerala Forest Department, Kerala, 2000. Pp. 90 + xxv, (22 x 14 cm). Price not mentioned.

The CHECKLIST OF INDIAN MAMMALS by Nameer P. Ommer is one of the most recent checklists of mammals of this country. It is quite comprehensive as it lists 417 species. Various naturalists have periodically studied the mammals of India, but their observations and results are scattered among various publications, journals and libraries. The information in this book has been painstakingly compiled from various sources. The primary sources of data are THE BOOK OF INDIAN ANIMALS by S.H. Prater, 1971, with additions from the *Journal of the Bombay Natural History Society*, which the author acknowledges as "the largest source of published information on Indian natural history." Due to numerous changes in taxonomic and nomenclatural status of many mammals, the information obtained was updated with inputs from MAMMALS FROM THE INDOMALAYAN REGION: A SYSTEMATIC REVIEW (Corbett and Hill, 1992) and THE CHECKLIST OF MAMMALS OF THE WORLD: A TAXONOMIC AND GEOGRAPHIC REFERENCE (Wilson and Reeder 1993). The marine mammals are listed with references from MARINE MAMMALS OF THE WORLD (Jefferson *et al.* 1993).

At the beginning of the book, the reader is introduced to Class Mammalia. There is then a brief discourse on the history of Indian mammalogy. We are then apprised of the mammalian orders found in India. There are two tables, one listing the number of genera and species per mammal family, and the other listing the number of endemic species per order with respect to the geographical region. After these preliminaries follows the checklist.

Ommer endeavours to provide us information on each species that has been listed, by mentioning the common name, vernacular name, geographical range within India and outside, and any bit of important information regarding nomenclature or distribution.

The overall impact of the book, however, is marred by a few omissions and errors. There is no precise mention of geographical range outside Indian limits for various Cetaceans, namely *Platanista gangetica* (p. 41), *Sousa chinensis* (p. 43) and the Sirenid, *Dugong dugong* (p. 48). Tibet has been mentioned as within Indian limits while describing *Otocolobus manul* (p. 39). This is partially compensated for by the thoughtful provision of two indices, one for scientific names and the other for common names.

The inclusion of names in vernacular dialect comes of use in the field when assistance from locals is required. Ommer has managed to restrict this checklist to a small slim volume, making it handy and fieldworthy. The checklist, therefore, is a useful reference for naturalists, students and laymen in their attempts to study Indian mammals.

■ MEGHANA GAVAND

2. PEOPLE, PARKS AND WILDLIFE: TOWARDS COEXISTENCE by Vasant Saberwal, Mahesh Rangarajan and Ashish Kothari. Orient Longman. Pp. 143, (21.5 x 14 cm). Paperback price Rs. 150/-.

THE TRACT FOR THE TIME series, published by Orient Longman, 'attempts to provide meaningful information, critical perspectives, and theoretical reflections on various themes of contemporary concern'. PEOPLE, PARKS AND WILDLIFE, the latest addition of this series, written by three eminently knowledgeable writers is a small book of 143 pages which should be read by anyone who is concerned with India's wildlife. It does not have glossy pages, with

exquisite pictures of tigers or butterflies or panoramic views of forests of the Western Ghats, so it may not appeal to people with amateur interest in wildlife conservation, but for serious researchers, protected area managers, human right activists and socio-economists, it is a 'must-read' reading. Vasant Saberval is a former research associate at the Institute of Social and Economic Change and his interests are ecology and environmental politics, while Mahesh Rangarajan is a well-known political commentator. He is equally interested in ecology and the history of the conservation movement in India. Ashish Kothari is perhaps the most famous amongst the three, due to his prolific writing and high profile activism. A former lecturer in environmental studies at the Indian Institute of Public Administration, he is presently coordinating the National Biodiversity Strategy and Action Plan, on behalf of the Government of India. The book contains 8 chapters and 22 pages of notes and references. The main theme of the book is that long-term sustainability of the conservation movement in India is not possible without the involvement of local communities living in and around protected areas. There should be a change in the vocabulary of conservation, from separation and exclusion of local communities to integration and inclusion. Besides saving threatened species and habitats, conservation should benefit local communities. "If isolationism worked in the past, it is doomed to failure in the long term. As human pressures and dissatisfaction grow, more fences will be broken down as the subsistence stakes rise, more forest guards will be beaten or killed as the economic stakes linked to the poaching of tigers, rhinos, bears and elephants increase, many more areas will be denotified at the instance of industrialists and politicians, supported by alienated village communities. Ultimately, if the Indian conservation movement cannot broaden its base beyond the middle class, it will simply collapse" (page 113).

The format and printing is excellent, I did not find any typos. But what is a South American macaw doing on the cover of a book that discusses the wildlife problems of India?

■ ASAD R. RAHMANI

3. THREATENED BIRDS OF THE WORLD by A.J. Stattersfield & D.R. Capper, (Project Managers and Senior Editors). BirdLife International and Lynx Edicions, Barcelona and Cambridge, UK, 2000. Pp. 852, (31 x 20 cms). Price not mentioned.

I could run out of superlatives to describe this book. Indian ornithologists and naturalists who are fortunate enough to read the books brought out by Lynx Edicions (HANDBOOK OF THE BIRDS OF THE WORLD, 6 volumes already published) and BirdLife International (PUTTING BIODIVERSITY, TOGETHER WITH BIRDS AND PEOPLE) will understand my predicament in not being able to find adequate superlatives. I rate HANDBOOK OF THE BIRDS OF THE WORLD as perhaps the finest, most comprehensive bird book in the world, both in production value and scholarly up-to-date descriptions of birds. The present book is also of the same quality. Beside the two senior editors, it has eight eminent ornithologists as additional editors. Maps, most of them having the latest distributional records, were supervised by Tim Morrisey along with three more people. The number of text contributors, evaluators, compilers and experts runs into hundreds. The book is based on historical and recent literature surveys, which can be judged by the reference section that runs into 48 pages. The work of 87 bird artists has been used in this profusely illustrated book. Each of the 1,186 threatened bird species is shown in its natural plumage. Donations for this book were made by hundreds of people and organizations, but the main

contribution came from the 1998 Birdwatching Fair, which raised US$ 200,000. In 1999, BirdLife International started a scheme for people to sponsor a particular species that also generated a lot of interest and funds. The information for Asian species is taken from the Asian Red Data Book Project, sponsored by the Environment Agency of Japan. Besides, RSPB, Wild Bird Society of Japan, Vogelbescherming of the Netherlands and NTT-ME (full form not given) and many others have also funded the project.

The book consists of nine major chapters, beginning with 'Extinction risk and opportunities for action', 'Documenting extinction risk', 'Assessing extinction risk', followed by 'How to use this book'. The fifth chapter, which is the main body of the book, describes 'Globally threatened species'. The sixth and seventh chapters describe Conservation Dependent, New Threatened and species of Least Concern. In the eighth chapter, Data Deficient, Not Evaluated and Extinct species are discussed. The final chapter lists species by territory. Although the whole book is worth reading, I particularly feel that the first three chapters should be read by anyone who is interested in bird conservation. BirdLife International and Lynx Edicions could bring out a separate supplement with these chapters, so that people like me who cannot afford the whole book can purchase the supplement. These chapters succinctly describe the problems birds are facing in the world.

BirdLife International and Lynx Edicions are to be congratulated for using the traditional bird classification and not Sibley and Monroe's (used by Grimmett *et al.* in their book BIRDS OF THE INDIAN SUBCONTINENT), so I find the book easy to use. For each of the 1,186 globally threatened species, common and scientific names, IUCN Red List Category, justification as to why the species is considered threatened, chief identication of the species, taxonomy, range and population, ecology, threats, conservation, targets for conservation actions, references, and sponsors are given. Maps, tables, box items, headings, digits and arrows are all in colour.

My only negative feeling after reading this book is that so many bird species are facing extinction in the world. I think there is no country in the world that does not have threatened species. The book lists 225 countries (including many protectorates and territories e.g. Hongkong, Tristan da Cunha, Macua, etc.) with their threatened species. The book is so thorough that even the tiny Liechtenstein (65 sq. m) is listed, with its vulnerable population of corn crake *Crex crex*. Even our two vulture species, once common, are included, as they have recently entered the threatened list.

After reading this book, I found an inner strength to re-dedicate my life for the protection of birds. I am sure others will have the same feeling. Nothing binds the world community more than a common cause — and for us the common cause is conservation. All over the world, birds are facing the same threats of habitat destruction, illegal hunting, invasive species, pollution, and so on. From the tiny Nukupu'u (*Hemignathus lucidus*) of the Hawaiian Islands to our own handsome sarus crane (*Grus antigone*), the problems are similar, and perhaps the solutions are also similar. The message of this book is that we all should work together to save the birds of the world.

We are fortunate that this marvellous book was gifted to the BNHS library by BirdLife International. It is an expensive book, so an average Indian birdwatcher and ornithologist would not be able to afford it. I think, to attract more members, we can very well publicize that one of the benefits of being a BNHS member is that you can see such wonderful books in the BNHS library! Any library would be proud to have THREATENED BIRDS OF THE WORLD.

■ ASAD R. RAHMANI

MISCELLANEOUS NOTES

1. OCCURRENCE OF SMALL INDIAN CIVET *VIVERRICULA INDICA* FAMILY VIVERRIDAE, IN THE MID-HILLS OF HIMACHAL PRADESH

The small Indian civet *Viverricula indica* is a true civet (Viverrinae) found in the Indian subcontinent extending from east of the Indus river in Pakistan to the whole of peninsular India southwards to Cape Comorin. Eastwards, its range extends to Myanmar, southern China and the Malay countries. According to Prater (1965), it has been recorded from the Himalayan foothills, living in dry or moist conditions, but it keeps out of heavy forest and prefers long grass or scrub to live in. The species also favours irrigated forest plantations, but avoids highly settled cultivated areas as well as mountainous regions of Pakistan (Roberts 1977).

While working in Chail Wildlife Sanctuary in Himachal Pradesh, the carcass of a small Indian civet was found at village Chhot in April 1997. The village is located at an altitude of 1,600 m on the southern slopes of the Chail Wildlife Sanctuary, where the vegetation is dominated by bushes and grasslands. The animal seems to have died a natural death, as the body bore no marks of injury. The species was never observed alive in the Sanctuary, mainly because it is strictly nocturnal. Though omnivorous, there were no reports of it feeding upon fruit crops. But there were definite reports of occurrence of another species of civet, the Himalayan palm civet *Paguma larvata* in and around Chail Wildlife Sanctuary. These animals are often killed by the farmers because of their frugivorous habit (Narang 1996).

The occurrence of small Indian civet in Chail Wildlife Sanctuary appears to be a stray incident. Nevertheless, it is perhaps the first record of this species occurring in the mid-hills of Himachal Pradesh.

ACKNOWLEDGEMENT

We thank the G.B. Pant Institute of Himalayan Environment and Development, Almora (UP) for financial assistance.

February 2, 2000

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2. WETTING OF NOSTRIL BY JACKAL *CANIS AUREUS* LINN., CARNIVORA, FAMILY CANIDAE

In the Sumer region of Kumbhalgarh Wildlife Sanctuary, Rajasthan, the summer is very severe and the day temperature can be unbearably high. During the end of May, a hot and dry wind blows constantly all day.

On May 29, 1999, I was sitting near a waterhole in a hide in Sumer. At 1425 hrs, a jackal waded into the water and started lapping it up. After drinking, it looked around, wet its tongue in the water and inserted the dripping

tongue into its right nostril. It repeated the process four times. Then it wet its left nostril by inserting the wet tongue into it thrice. After this, it trotted away.

Due to severe heat and dry wind, the nostrils probably became dry and hard, causing discomfort and the jackal inserted its tongue into the nostril to moisten the inner side of its nose. I took a photograph of the jackal wetting its nostril.

February 2, 2000

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3. SLOTH BEAR *MELURSUS URSINUS* SHAW AND POWER METER

The Sumer rest house, situated in the Kumbalgarh Wildlife Sanctuary, is located in a secluded place away from Sumer village. About 100 m from the rest house there is a well, which provides water to the rest house and to two waterholes nearby. To pump water from the well, there is an electric motor, with the switch board and meter fixed in a small room over the platform of the well.

Except when visited by forest officers or tourists, the rest house remains unguarded, for fear of sloth bears. In summer, water is found at four places in the vicinity. Sloth bears occasionally visit the rest house after quenching their thirst from the waterholes nearby. Sometimes they also enter the rooms, possibly attracted to the food left behind by visitors. On several occasions, I have seen sloth bear scats in the verandah and in the kitchen.

On one occasion, a sloth bear came to the waterhole near the well, and after quenching its thirst, climbed onto the platform, from where it apparently heard the humming sound of the meter. The bear possibly took it to be the humming of honey bees, for it broke open the door of the room and smashed the meter in search of honey. Instead of honey, it received a severe jolt from the electric current. The bear howled repeatedly for several minutes and then ran off.

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4. NEW RECORDS AND STATUS OF BLACKBUCK *ANTILOPE CERVICAPRA* IN BUENOS AIRES PROVINCE, ARGENTINA

Blackbuck was first introduced into Argentina for sport hunting in 1906, in La Pampa province. In 1912, there were further releases in Santa Fe, Cordoba and Buenos Aires provinces (Lever 1985). It became well established in these four localities, and lately in Entre Rios and San Luis provinces (Chebez 1994). The dispersal of the species has been assisted by translocation to new, previously uncolonized areas, mainly as a result of commercial interest from game ranches. Buenos Aires province manages blackbuck as a big game species, and permits shooting to control populations and for the wild meat market. There is extensive evidence that blackbuck has a detrimental impact on native biota and agricultural produce (Navas 1987). However, there have been no substantial studies on the species distribution, population biology, or impact on local ecosystems of Argentina.

From 1995 to 1997, we made field surveys in the potential distribution range areas. We also compiled all the literature and unpublished

information at the local Wildlife Department, to determine the current distribution and status of *Antilope cervicapra* in Buenos Aires province.

There are 11 game ranches (50% of the total legally established ranches) with blackbuck populations. The sport hunting season traditionally opens from March 15 and extends to December 31, based on the notion that fawns are born in summer (January and February). Despite this, there are records from captive and wild populations about females giving birth throughout the year. 53 male trophies have been legally taken from game ranches in 1995, 44 in 1996 and 103 in 1997, most of them by foreign hunters. In 1997, there was at least one permit issued for commercial harvesting.

The previous record of distribution (Galliari *et al.* 1991) has now been expanded. We confirmed the occurrence of blackbuck at the Chascomús, General Belgrano, Castelli, Bahia Blanca and Guamini departments. Additionally, new records were made for the species at Pila, Dolores, Adolfo Alsina, Coronel Suarez and Coronel Dorrego departments. The biggest and better established population has its nucleus in 'La Corona' and 'La Guarida del Zorro' game ranches, an area of approximately 12,000 ha, in General Belgrano near the Chascomús district boundary. In 1996, from preliminary line transect censuses, we estimated a population of above 6,000 animals, with a density of 0.56 individual per hectare. However, in 1997, the population was commercially harvested for the meat market, showing a marked decline since this event. We suggest further studies on the species' impact on local biota, to stop uncontrolled translocations, and a closer monitoring of the effect of sport and commercial harvesting on the blackbuck.

We thank Claudio and Sergio Quagliata for their help in the field censuses and for access to their captive population.

March 2, 2000 BRUNO CARPINETTI
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5. INCIDENCE OF AN ELEPHANT CALF *ELEPHAS MAXIMUS* TRAPPED BETWEEN TWO TREE TRUNKS

The first year is considered to be the most vulnerable stage in an elephant's life, when mortality rate ranges from 10% to 30% (Douglas 1972, Barnett 1991). Annual mortality rate of elephant calves aged less than one year is reported to be 36% in Tsavo National Park, Kenya (Laws 1969). Studies on annual mortality rate in Indian elephant calves (*Elephas maximus*, age <5 years), in Biligiri Rangan Temple Wildlife Sanctuary, South India, was reported to be 4-5% in female and 8-9% in male elephants (Sukumar 1989). Elephant calves are known to die of diseases, intra-specific fights, drowning in floods, landslides, tiger predation, snake bite poisoning,

accidents (including falling off cliffs, bridges, into trenches, drains) in the wild (Asian Elephant Research and Conservation Centre (AERCC), unpublished data; Daniel 1998). About 9.5% of the 208 records, scanned from 1975-1994, of elephant calf deaths were accidental (AERCC, unpublished data).

Among the known causes of death, or near death situations due to accidents, getting trapped between tree trunks is very rare. We observed one such incident on the morning of May 4, 1999, during fieldwork under the Karnataka Tiger Conservation Project at Kaimara, Nagarhole National Park, South India. An elephant calf, estimated to be ten months old, was found trapped between two tree trunks (*c.* 30 cm diameter at breast height), which were less than 30 cm apart. The calf probably got trapped the previous night, since we heard elephants trumpeting in the area throughout the night and till the following forenoon.

The calf was exhausted and had blood trickling down its forehead. Amongst the many who had gathered there, four of us tried to release it by lifting and pushing it across the fork. We failed to lift the calf high enough to release it. In the process, the calf jerked itself free from us and relapsed into its original trapped position. As the elephant herd was moving closer, we fled the spot. Two kurubas (local tribesmen) bravely went back after some time and released the calf. It rested for about ten minutes after its release and then moved dizzily down to the nearby stream. After a couple of hours, the calf was no longer found in the vicinity and it was presumed to have rejoined its herd. Had the calf not been rescued, it is possible that it would have died of starvation, dehydration, predation, or injuries caused by the herd trying to extricate it. The tribesmen mentioned that it was the second such incident that they had witnessed, the first one being a few years ago in the forest adjoining the Park.

Two similar incidents are worth adding to this note. Mr. Kullayya, Mahout, Karnataka Forest Department, recollected a similar incident (*pers. comm.*) which had occurred a decade ago. The foreleg of an elephant calf (*c.* 5 years old) was trapped between the roots (diameter *c.* 30 cm) of a tree abutting a stream near Sunkadakatte Forest Rest House, Nagarhole National Park, the calf had a slip in the shoulder joint and its legs were swollen. The entangling tree root was cut to free the calf, which was later treated at the camp. Nevertheless, the calf could not recover and died after a month.

In 1997, according to Dr. Nanjappa (*pers. comm.*), Veterinary Officer, Karnataka Forest Department, the leg of an elephant calf (*c.* 2 years old) was trapped between boulders in the steep terrain of Maddur Range, Bandipur National Park. The incident was reported to the veterinarian two days later. The Forest Department personnel had to break the boulders to free the calf, which had a concussion and its legs were swollen. The calf was given fluid therapy, but it did not recover even after medical treatment and died the following day.

Though it is difficult to imagine that such incidents occur in the wild, we suggest that this could be considered as one of the causes of infant mortality among wild elephants.

Acknowledgements

We are grateful to Dr. Nanjappa and Mr. Kullayya of the Karnataka Forest Department, for sharing their experiences with us. We thank the Karnataka State Forest Department and the AERCC, Bangalore, for data on elephant calf mortality and Ms. Cheryl Nath for references.

April 14, 2000

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6. A NOTE ON SOME FOOD PLANTS OF THE MALAYAN GIANT SQUIRREL *RATUFA BICOLOR* IN GIBBON WILDLIFE SANCTUARY, JORHAT, ASSAM

The Malayan giant squirrel (*Ratufa bicolor*) is arboreal (Prater 1980). During our studies on plant-animal interaction with special reference to primates of Gibbon Wildlife Sanctuary (WLS), Assam, we noted some interesting dietary habits of the Malayan giant squirrel. Gibbon WLS is a newly constituted sanctuary situated about 20 km southeast of Jorhat town in upper Assam and lies between 26° 40'-26° 45' N and 94° 20'-94° 25' E. Prior to its declaration as a sanctuary it was a reserve forest under the eastern Assam forest circle. The sanctuary is famous for its diversity in primate species, 7 non-human primate species being found within 19.5 sq. km fragmented forest habitat (Bujarbarua and Chetry 1999). All the records were made between October 1998-September 1999.

Ratufa bicolor fed on parts of 37 plant species in Gibbon WLS. Most of the food plants were identified on the spot, the unidentified specimens were collected and later identified in the herbarium of the Botany Department, Gauhati University, with the help of FLORA OF ASSAM (Kanjilal 1940). All the food plants are trees and are listed in Appendix I, with parts eaten by the squirrel.

The squirrel primarily fed on pericarp and sometimes on fruit pulp. In some cases, it consumed the seeds. The squirrel gnaws at the pericarp of the fruits and eats the cotyledons. Insect larvae (mainly those of ants) and small spiders are also eaten.

From our observations, *Ratufa bicolor* is certainly frugivorous. Morton (1973) has noted that among frugivorous birds there may be intense selection pressure, favouring the ability to exploit a wider variety of food in periods of fruit scarcity. The Malayan giant squirrel, which feeds mainly on fruits, probably experiences the same selection pressure, and may take to a broad array of foods during periods of fruit shortage.

ACKNOWLEDGEMENTS

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April 6, 2000

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Appendix – I

	Plant Species	Family	Parts Consumed
1.	*Mangifera indica*	Anacardiaceae	Pericarp
2.	*M. sylvatica*	"	"
3.	*Drimycarpus racemosus*	"	Entire fruit
4.	*Spondias mangifera*	"	Flower/Fruit pulp
5.	*Bombax ceiba*	Bombacaceae	Flower bud
6.	*Canarium resiniferum*	Burseraceae	Entire fruit
7.	*Garuga pinnata*	"	"
8.	*Terminalia belerica*	Combretaceae	"
9.	*T. chebula*	"	Pericarp
10.	*T. myriocarpa*	"	Inflorescence/Flower
11.	*Tetrameles nudiflora*	Datiscaceae	"
12.	*Dillenia indica*	Dilleniaceae	Juice of fleshy calyx
13.	*Vatica lancaeifolia*	Dipterocarpaceae	Seed
14.	*Elaeocarpus floribundus*	Elaeocarpaceae	Pericarp
15.	*Sapium baccatum*	Euphorbiaceae	Fruit pulp
16.	*Bischofia javanica*	"	Entire fruit
17.	*Casanopsis indica*	Fagaceae	Nut (Seed)
18.	*Garcinia cowa*	Guttiferae	Fruit pulp
19.	*G. pedunculata*	Guttiferae	Fruit pulp
20.	*Litsea polyantha*	Lauraceae	Pericarp
21.	*Cryptocarya* sp.	"	"
22.	*Duabanga sonneratioides*	Lythraceae	Thalamus (ovule)
23.	*Michelia montana*	Magnoliaceae	Pericarp
24.	*Dysoxylum binectariferum*	Meliaceae	"
25.	*Ammora wallichii*	"	"
26.	*Cedrella toona*	"	"
27.	*Chikrassia tabularis*	"	"
28.	*Artocarpus chaplasha*	Moraceae	Juicy ovary
29.	*A. heterophyllus*	"	"
30.	*Ficus benjamina*	"	Entire syconia
31.	*F. lepidosa*	"	"
32.	*Eugenia jambos*	Myrtaceae	Fruit pulp
33.	*E. jambolana*	"	"
34.	*E. kurzii*	"	"
35.	*Eucalyptus maculata*	"	Bark
36.	*Dendrobium* sp.	Orchidaceae	Fruit
37.	*Anthocephalus cadamba*	Rubiaceae	Flower/Nectar

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7. BURROW MORPHOLOGY OF FIELD RODENTS OF KYMORE PLATEAU, SATPURA HILLS

(*With four text-figures*)

Study of the burrow morphology of major field rodents, namely lesser bandicoot *Bandicota bengalensis* (Gray), soft furred rat *Millardia meltada* (Gray) and field mouse *Mus booduga* (Gray) was undertaken in the Kymore Plateau of Satpura Hills. For this purpose, 24 active burrows of *Bandicota bengalensis*, 28 of *Millardia meltada* and 36 of *Mus booduga* were excavated over a large area. Their burrowing patterns (Figs 1, 2, 3 & 4), amount of soil excavated, number of burrow openings (emergency escape), burrow diameter and burrow depth (Table 1) were studied in harvested wheat fields.

Observations on active burrows revealed that each of these three rodents had a unique burrow pattern. That of *B. bengalensis* was complicated, well architectured, and had distinct runways, of which some are interconnected, and with granaries entering into one or more strata of the soil (Prakash 1975, Jain 1985, Dubey and Thakur 1997). *M. meltada* had a simple and elongate single tier burrow system, whereas *M. booduga* had simple, shallow burrows. In most cases, the burrow entrance of *B. bengalensis* had a large heap of soil with large pebbles, while *M. booduga* had a smaller heap of soil with small pebbles before the burrow opening. In *M. meltada* burrows, the heap of soil was usually absent, but medium sized pebbles (Neelanarayanan *et al.* 1994) were used. Hoarding behaviour was also observed, which is a fairly common and characteristic feature to assure a continuous supply of food against seasonal fluctuation. In

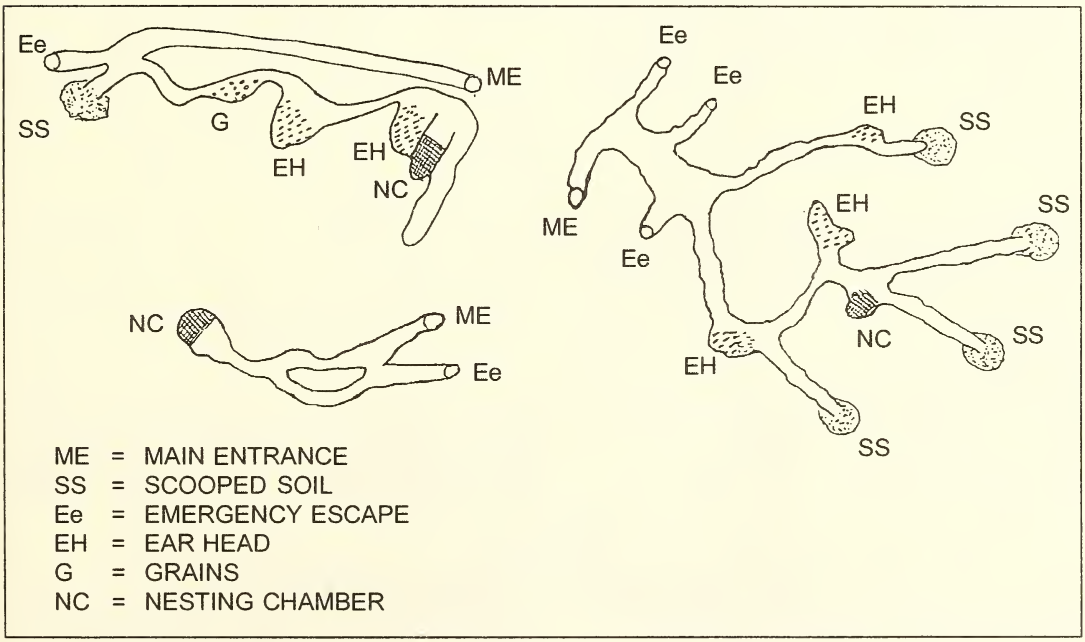

Fig. 1: Burrow structures of *Bandicota bengalensis* in paddy field

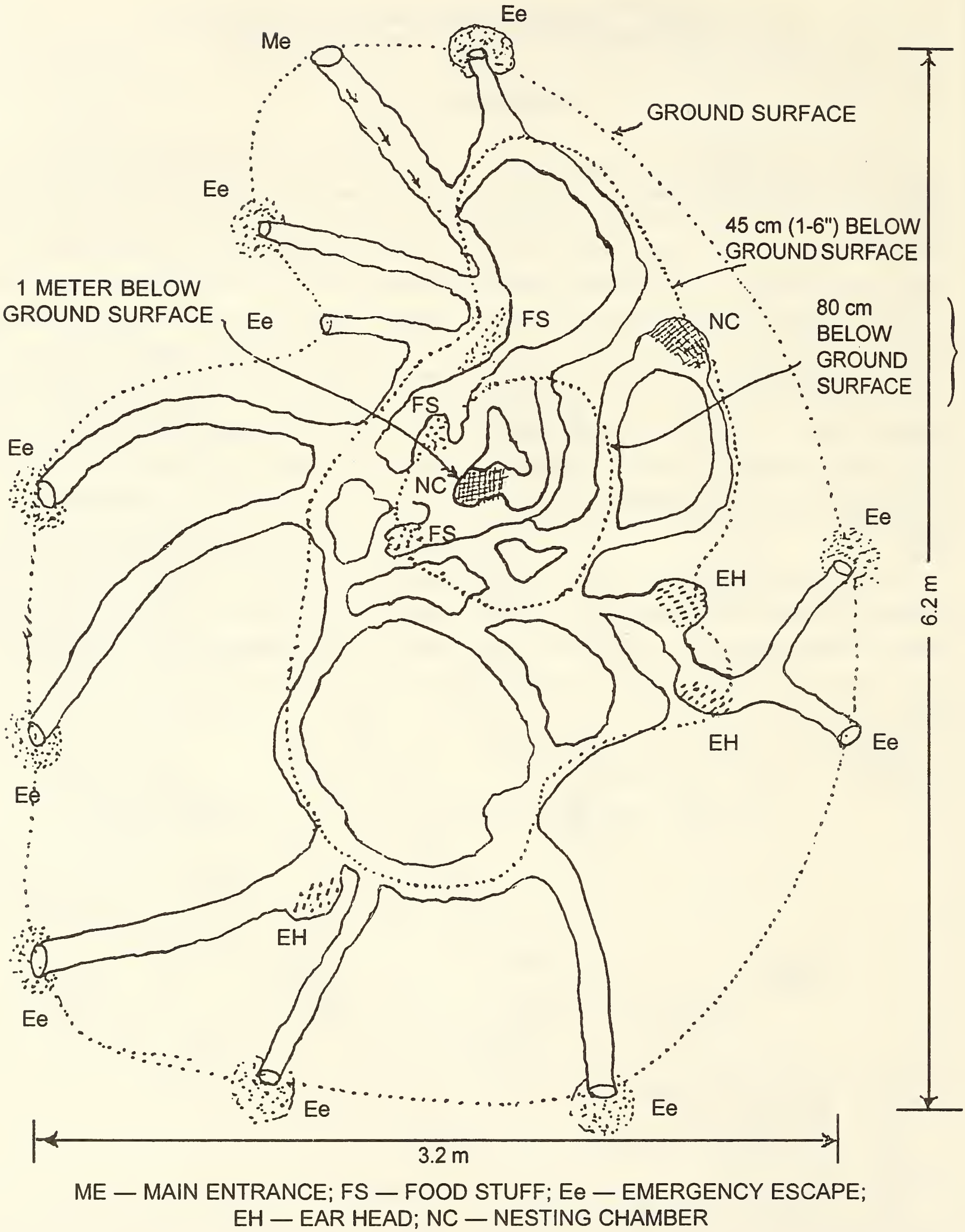

Fig. 2: Complicated burrow structure of *Bandicota bengalensis* in wheat field

TABLE 1
OBSERVATIONS ON BURROWING BEHAVIOUR OF MAJOR RODENT SPECIES

Rodent Species	No. of burrows observed	MEAN			
		Amount of soil excavated (kg)	No. of burrow opening (emergency escape)	Burrow diameter (cm)	Burrow depth (cm)
Bandicota bengalensis	24	50.86 ±4.49 (3.0-138.0)	3.9 ±3.28 (1-11)	7.5 ±5.08 (2.5-16.5)	55.85 ±34.03 (20.2-110.3)
Millardia meltada	28	2.03 ±1.34 (0.5-3.5)	2.0 ±1.15 (1-4)	2.9 ±1.36 (2.1-4.2)	22.57 ±6.14 (15.0-30.2)
Mus booduga	36	0.98 ±0.72 (0.1-2.7)	1.2 ±0.40 (1-2)	2.4 ±0.33 (2.0-5.0)	17.39 ±3.36 (10.5-20.0)

Nos in parentheses indicate ranges

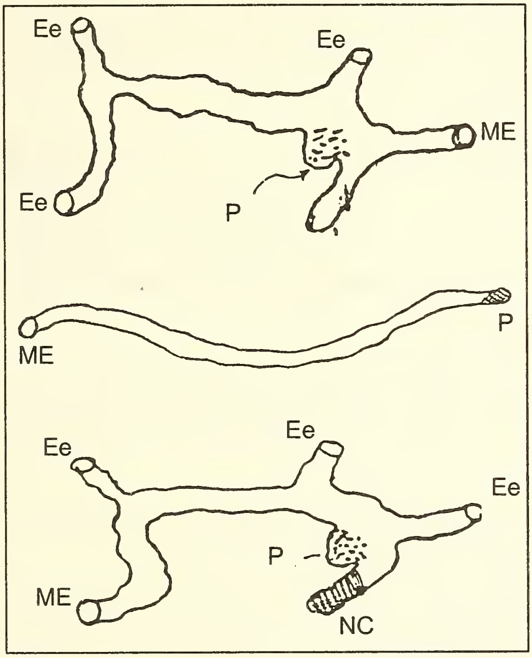

Fig. 3: Burrow structure of *Millardia meltada* in chickpea field

the lesser bandicoot and soft furred rat, hoarding is prevalent particularly in the pre-harvest period. On an average, 4.28 kg ears of wheat were recorded from the burrow of *B. bengalensis* and 0.53 kg from *M. meltada*. Hoarding provides the young rodents with food at a short distance, which can be reached without exposure to predators.

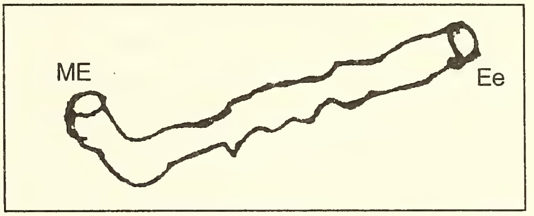

Fig. 4: Burrow structure of *Millardia booduga* in chickpea field

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8. THE BARHEADED GOOSE *ANSER INDICUS* LATHAM IN BHAVNAGAR, SAURASHTRA

Bhavnagar (21° 45' N and 72° 08' E) is located on the northeast side of peninsular Saurashtra, Gujarat state, along the coast of the Gulf of Khambhat. On the morning of December 27, 1998, my friend and I visited the Surka village pond for the census of winter migratory birds. The pond is 30 km to the west of Bhavnagar city. While watching waterfowl, we noticed a large bird with distinctive black bars across the nape, grazing along with a flock of ruddy shelduck (*Tadorna ferruginea*) on the bank of the reservoir. It was identified as a barheaded goose (*Anser indicus* Latham). This is the first record of the barheaded goose from Bhavnagar district. It is very rare in Saurashtra, where the first specimen recorded was from Jamnagar in 1951 (Dharmakumarsinhji 1955), while in January 1984 a flock of 22 barheaded geese were recorded in Mulidam, Surendranagar district (Raol 1988). Usually it is a winter visitor to northern and northeast India (Ali and Ripley, 1987).

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9. MORE INFORMATION ON SHIKRA *ACCIPTER BADIUS* (GMELIN) FEEDING ON SHORTNOSED FRUIT BATS *CYNOPTERUS SPHINX* VAHL.

With reference to the note by Manoj Muni and Vithoba Hegde (*JBNHS, 1998, 95(2)*: 338-339) regarding the preying habits of shikra (*Accipter badius*), I narrate my recent observation on the same habit recorded in the campus of Aligarh Muslim University, Aligarh, Uttar Pradesh, India.

The predation by this bird on shortnosed fruit bats (*Cynopterus sphinx*) seems to be a common phenomenon, though not reported earlier than Muni and Hegde (1998).

On the morning of October 1, 1998, the sky was dark and cloudy, and I was in the balcony of my hostel room, observing shortnosed fruit bats emerging from dried fronds of the palmyra palm (*Borassus flabellifer* Linn.). This was due to the change in the intensity of light. This tree has been a roosting site of the bats for a long time.

As the bats started flying near the palm, I saw a juvenile shikra (*Accipter badius*) come out of the dried fronds of the palm with a bat in its talons. The bird sat on the nearby copper pod tree (*Peltophorum pterocarpum*) and started tearing at the flesh of the bat. The bat was alive for about seventeen minutes while being eaten by the bird. At 1005 hrs, it started raining heavily, and I could not make any further observations.

The next day, at 1215 hrs, the sky was dark and overcast. With a camera in hand, I sat in the balcony to observe the behaviour of the shikra. The bats started emerging from the dried fronds of the palmyra palm. At the same time, four shikras arrived on the scene, one was a juvenile and the rest were adult. They started chasing the bats, but no capture was seen. This went on till 1510 hrs. Subsequently, rain once again forced the bats to go back to their roosting site.

This observation, and that of Muni and Hegde (1998), shows that the shikra is a common predator of shortnosed fruit bats.

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10. PREDATORY ATTACK ON BATS BY BARN OWL *TYTO ALBA* AND SHIKRA *ACCIPITER BADIUS* IN TAMIL NADU STATE, SOUTH INDIA

Evidence of predators having a significant effect on bat populations is sparse. Few predators specialize on bats, but the largely anecdotal literature cites many occasional bat-eaters such as monkeys, racoons, opossums, cats, raptors, snakes, frogs, spiders and bats themselves (Altringham 1996). Avian predators such as owls, hawks and falcon are known to attack and feed on bats occasionally (Gillette and Kimbourgh 1970). Bats are particularly vulnerable to aerial predators when they leave their roosts or while feeding at night. India is home to about a hundred species of bats, and at least eleven species of avian predators have been observed to prey on bats occasionally in the past (Muni and Hegde 1998). Since July 1995, we have been conducting bat surveys in Nagai district, Tamil Nadu, India (Agoramoorthy and Hsu 1998). We observed three cases of predatory attacks on bats, two by a barn owl *Tyto alba*, and one by a shikra *Accipiter badius*. All three cases were observed in Tirunagiri village which is located near the town of Sirkali in Nagai district.

The first case of predatory attack by shikra was observed during the day near a bat roosting site. In the second and third case, the bats were attacked by barn owl while they were emerging at dusk, and while foraging at night.

Case 1: On August 2, 1995 at 1100 hrs, we studied a colony of 250 black-bearded tomb bats *Taphozous melanopogon* located in the gateway of the Vishnu temple at Tirunagiri village, Nagai district. When a temple worker climbed on to the gateway, some bats flew into darker spots in the temple. Just then, one bat came outside and was immediately captured by a shikra that flew from the top of the temple gateway's exterior and disappeared into the forest with its catch.

Case 2: A colony of 400 greater false vampire bats *Megaderma lyra* regularly roosted in an abandoned house at Tirunagiri village. On September 6, 1996, at 1830 hrs, the false vampire bats emerged from their roost. One bat was seen isolated from a group of 20 individuals. Suddenly, a barn owl flew from the roof of the house, stooped 4 m downwards and then flew about 10 m in pursuit of the bat and caught it while the bat was in flight. The owl captured the bat with its beak and claws simultaneously, and apparently swallowed it in flight. The attack lasted about 6-7 seconds. The site where the owl rested earlier was checked, and pellets with skulls and bone remnants of rodents and bats were found.

Case 3: On September 26, 1996, at 2130 hrs, a male barn owl was seen resting on a palmyra palm tree *Borassus flabellifer*, about 7 m above the ground at Tirunagiri village. Approximately 10 m away from the owl, about 30 shortnosed fruit bats *Cynopterus sphinx* were flying and feeding on mahua *Madhuca indica* fruit. They were about 4 m above the ground while feeding.

One shortnosed fruit bat moved from the group and came close to the palm tree where the owl was resting. Immediately, the owl swooped and captured the bat in flight and returned to the tree where it had been perching. It rested there with the bat for about 10 seconds, got a firm grasp on the bat with its feet, and flew away. The bat did not produce any screams audible to human ears.

In South Africa, Fenton *et al.* (1994) reported 59 attacks by diurnal raptors on bats and the predators included hobby falcon *Falco subbuteo*, African goshawk *Accipiter tachiro* and Wahlberg's eagle *Aquila wahlbergi*. Similarly in south-eastern Australia, Speakman *et al.* (1994) released bats during daytime to test the predation rates, and observed 11 attacks by diurnal predatory birds. Shortnosed fruit bats *Cynopterus sphinx* usually produced shrill screams when we handled them in mist nets, but the bat attacked by the barn owl did not scream. However, Fenton *et al.* (1994) report that bats taken by raptors uttered screams clearly audible to human ears. Bat bones were seen in owl pellets, and African barn owls *Tyto alba* were reported to attack and eat individuals of *Rousettus aegyptiacus* (Hill and Smith 1984). Although Speakman (1991) reported that bats made up only a small part of the diet of owls in Britain, Julian and Althringham (1994) predicted that individual owls could take large numbers of bats, and may influence the population size in bat colonies. Only two cases of barn owl predation have been observed during our study, and more data are needed to evaluate whether or not owl predation influences the population size of bats around Tirunagiri village in Nagai district, Tamil Nadu.

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11. A NOTE ON SARUS CRANE *GRUS ANTIGONE* MORTALITY DUE TO COLLISION WITH HIGH-TENSION POWER LINES

The sarus crane (*Grus antigone*) is the only resident crane species breeding in India, south of the Himalayas. Few long term studies have been carried out and information on its mortality

is limited and scattered (Gole 1989, Parasharya *et al.* 1991). Largely, human pressure and associated changes in land use patterns, and intensification in agriculture are major threats to the cranes (Meine and Archibald 1996). Egg stealing, hunting, trade in live birds and death due to ingestion of pesticides by adult birds are the other known threats (Gole 1989, Muralidharan 1992, Sundar *et al. in prep.*). Mortality due to electrocution has been documented rarely (Parasharya *et al.* 1991) and its impact on sarus crane population dynamics is not quite clear.

During a survey in the states of Punjab, Haryana, Rajasthan, Gujarat, Uttar Pradesh, Maharashtra, Bihar and Madhya Pradesh, from June to October 1998, to determine distribution and status of the sarus crane in India, we recorded three instances of crane mortality due to collision with high-tension electric cables. In Aligarh district, Uttar Pradesh, one adult female was found freshly killed in this manner near Shekha Jheel on June 24, 1998. The bird was one of a pair that the locals had seen for the past couple of years breeding in a nearby paddy field. The crane apparently came in contact with the wires over the paddy field while landing to roost for the night. The male stayed near the female body for a day (as in Ali and Ripley 1980) and then flew away. Another case was recorded in Mainpuri, Uttar Pradesh, on June 28, 1998. While carrying out a road transect near the Saman Bird Sanctuary, we saw two sarus cranes killed in the same way. These two birds had been partially eaten by vultures and the sexes could not be determined from the carcasses. In Aligarh, the survey revealed five cranes in the vicinity of the Shekha Jheel (over 15 kms) and 79 birds were counted in the Mainpuri road transect (covering 50 kms).

Bird collisions with power lines are a common phenomenon the world over, waterfowl and passerine birds having the highest known collision rates (Cornwell and Hochbrum 1971, Morkill *et al.* 1990). Some authors have remarked that these mortalities are not biologically significant to bird populations (Stout and Cornwell 1976), but are detrimental to endangered bird species or for populations of birds which have high local concentrations (Morkill *et al.* 1990). Collision is a major cause of mortality in several crane species the world over. For example, the major cause for death of fledged adult whooping crane (*Grus americana*) is found to be collision with high-tension power lines (Lewis 1986). Morkill *et al.* (1990) have found similar results in sandhill crane (*Grus canadensis*), having recorded 126 incidents of crane mortality between 1988-89. Records of red-crowned crane (*Grus japonensis*) populations from the 1950s onwards showed a stage of reduced growth rate, when 71% of 79 deaths in 1970-74 were due to collision with electric cables (Masatomi 1987).

While the trends in sarus crane mortality and repercussions on the local populations are unclear from our data, it is one step towards long-term studies. The number of deaths seems quite low in the Mainpuri area, while it is a significant proportion of the total number of resident birds in the Aligarh district. Long-term collection of data in these localities over larger areas is necessary and may reveal the impact of such mortality on the populations of the sarus cranes. With the national power grid network and several state electrical corporations planning expansion of high-tension power lines, their impact on large-bodied migratory and resident birds such as cranes can looked into, to avoid the major flyways and migratory paths.

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12. OCCURRENCE OF GREAT INDIAN BUSTARD *ARDEOTIS NIGRICEPS* AT HOSUR, NASHIK DISTRICT, MAHARASHTRA

Three great Indian bustards *Ardeotis nigriceps* were sighted by one of us (BR) at the Hindustan Aeronautics Ltd (HAL) complex at Hosur, 20 km from Nashik towards Dhulia, on National Highway 3 on September 2, 1998. On subsequent visits, a single bird was sighted on September 24, 1998, and three birds on September 25, 1998. The birds are seen regularly on the runway by the Air Traffic Control (ATC) staff (Mr. Kale *pers. comm.*). Two chicks were observed in 1998, while displaying males are regularly sighted in the monsoon. According to the ATC staff, a maximum of nine birds have been recorded in the area, since at least 1974 (Mr. Kale *pers. comm.*).

The HAL complex is a huge area, encircled by a 13.5 km perimeter wall. Most of the 14.3 sq. km area is open grassland, except for the small area occupied by the office and factory buildings. The HAL complex is largely used to repair military aircraft, which are test flown from a runway that almost bisects the grassland.

The area is gently undulating, dominated by the forbs of *Borreria* sp. and *Boerhavia* sp., and grasses of *Chrysopogon* sp. The vegetation height is about 1.5 m. There are a few scattered *Acacia nilotica* trees and *Ziziphus* bushes. There is no human activity except for the occasional flying military aircraft, and movement of security personnel between the outposts. There is no cattle grazing, while grass is burnt only along the runway by the authorities during summer. Good grass growth is observed within the inner perimeter wall, which is a high security area.

But between the inner and outer perimeter walls and beyond the outer perimeter wall, the area has been denuded by livestock grazing.

There was no record of the bustard in Nashik district (Rahmani 1989), although it was recorded in the neighbouring districts of Ahmednagar and Dhulia. Rahmani (1989) mentions unconfirmed reports of its occurrence in Nashik district. We think it worth putting on record the first confirmed sighting of this highly threatened species from a hitherto unreported site.

The fact that these birds are present in the area at least since 1974, and the scientific community was oblivious to their presence, calls for renewed intensive efforts to identify areas where bustard populations are still present. This should give a better understanding of its status in the country. Constant monitoring of the population will tell whether bustards are seen in this area throughout the year, or that they come only for breeding.

The only threat to the bustards in this high security area are flying aircrafts, but since the flight frequency is very low, the probability of an aircraft hitting a bustard is also low.

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13. SIGHTING OF SOCIABLE LAPWING *VANELLUS GREGARIUS* IN KACHCHH DISTRICT, GUJARAT

While on a field trip to Lala Bustard Sanctuary, in Abdasa taluka, Kachchh district, we sighted a pair of sociable lapwing *Vanellus gregarius* on December 29, 1998 at 0900 hrs, feeding in a ploughed field close to Lala village. The birds were in non-breeding or winter plumage, and were foraging actively. The ploughed field was set amidst fallow land and degraded grassland. The birds had a very distinct white supercilium, a black eye-stripe extending to the nape, and a black crown. The upper part of the bird was ashy brown and the entire belly was white. The bill and legs were somewhat black. Our efforts to find the birds again the next day were in vain.

This species is threatened globally and considered vulnerable (Collar *et al.* 1994). The last sighting in Kachchh was in August 1947 (G.M.B. Sparks, unpublished data; M.K. Himmatsinhji, *pers. comm.*). Dharmakumarsinhji (1956) has mentioned that it is an irregular visitor, not common and usually seen during the cold (winter) months. Ali and Ripley (1995) have also mentioned that it is a migrant, found in dry wastelands, ploughed fields and stubble. Collar *et al.* (1994) say that it uses grasslands and wetlands, including littoral habitats.

The sociable lapwing is said to breed in southeastern Russia and to migrate south to North Africa and India, including Kachchh and other parts of Gujarat (Dharmakumarsinhji 1956).

Efforts are being made by us to look for this species in Kachchh, as part of a project on Conservation of the Rare and Endangered Biodiversity of Kachchh, Gujarat, funded by the Gujarat Ecology Commission.

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14. OCCURRENCE OF THE WHITE-WINGED BLACK TERN *CHLIDONIAS LEUCOPTERUS* IN KERALA

During our field trips in the Enamavu, Kole wetlands of Thrissur, Kerala, between September 12-15, 1998, Paul, P.M.K., C.K. Sujithkumar and I came across a few unfamiliar tern species feeding over the freshly drained paddy fields along with whiskered terns *Chlidonias hybrida*. Some of these were in partial breeding or post-breeding plumage, so that we could easily identify them as the white-winged black tern *Chlidonias leucopterus*.

On the evening of September 12, we saw at least three individuals (one adult and two juveniles) of this species feeding amongst a group of the whiskered terns. During flight, the black underwing coverts were the most noticeable feature of the adult bird. Mantle and back, black or blackish. Upper wing mostly smoky grey. Upper primaries deep ashy grey. A trace of whitish panel on upperwing coverts. Forehead white. Hind crown and ear-coverts (behind eyes) black. A white collar on hind neck. Underparts wholly white. Under primaries grey. Rump and tail totally pure white. But the middle tail feathers were light grey. The shallow tail fork was sometimes visible (sometimes appeared nearly square). Bill black, legs and feet red. The red legs were occasionally seen as they trailed in feeding flight.

The mantle and back of the juveniles were dark brown; upper wing smoky grey; an indistinct paler panel on upperwing coverts. Underwing mostly whitish; no black on underwing coverts. The remaining features were similar to the adult.

The following afternoon, we observed the same number of birds feeding in the same area. But the underparts of the adult bird were quite different, being black mottled with white.

On the last day at 1430 hrs, we could see two adults hawking their prey over the grassy paddy fields, somewhat like swallows. One of these had an entirely black head and body, except for the white forehead and little white blotches on the underparts.

There is no earlier published record of the white-winged black tern in Kerala.

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15. SIGHTINGS OF WHITECHEEKED TERN *STERNA REPRESSA*, WHITEWINGED BLACK TERN *CHLIDONIAS LEUCOPTERUS* AND SAUNDERS'S LITTLE TERN *STERNA SAUNDERSI* AT PORBANDER COAST, GUJARAT

Porbander (21° 37' N, 69° 49' E), a small coastal town on the west coast of Gujarat, is an important area for birds. A wide intertidal zone, a muddy creek with mangroves encircling the town, extensive saltpans on the outskirts, fishing industry and a small (3.1 ha) bird sanctuary on the sewage dump are all bird habitats. Various tern species observed at Porbander during a few visits in 1997 are recorded here.

On June 17, 1997 we saw several terns slightly larger than the whiskered tern *Chlidonias hybrida* flying above the salt pans. An osprey *Pandion haliaetus* caught one of them and landed on a stone about 60 m from us. The other terns mobbed the osprey and landed nearby. Closer examination revealed that all the 35 birds were whitecheeked tern *Sterna repressa* in non-breeding plumage. A flock of 450 other terns was also seen pursuing each other with chirping calls.

The whitecheeked tern is known to breed on Vengurla Rocks off Malvan on the west coast, *c.* 16° N, 73° 30' E (Ali and Ripley 1983). It is common on the Makran and Sindh coasts of Pakistan, particularly from March to May, but there is no evidence of its breeding (Ali and Ripley 1983). However, a specimen was collected on June 12, 1973, at Bombay harbour (Menon 1974). This species has never been reported from Gujarat coast and hence, this is the first record.

Though it was June 17, we also recorded the gullbilled tern *Gelochelidon nilotica* (1), Caspian tern *Hydroprogne caspia* (2), whiskered tern *Chlidonias hybrida* (8) and Saunders's little tern *Sterna saundersi* (2).

On April 27, we saw 3 whitewinged black tern *Chlidonias leucopterus* repeatedly flying over the waters of the bird sanctuary. Two birds had complete breeding plumage, whereas the third one still had some white patches on the black belly. These three terns were foraging along with 16 whiskered terns *Chlidonias hybrida*. The whitewinged black tern is a rare visitor to Assam, West Bengal, Bangladesh and Sri Lanka (Ali and Ripley 1983). There have been three records of this species from Gujarat: twice from Jasdan (Shivrajkumar 1955) and once from Jamnagar (Mundkur 1987). Sighting of three birds from the Porbander coast indicates that the species occurs over a greater area of Gujarat state and is less vagrant than recorded (Ali and Ripley 1983). Sangha (1998) reported the species from Rajasthan, which further supports this view.

We also saw two flying Saunders's little tern *Sterna saundersi* from a very short distance on April 27 and June 17. This tern is known to breed around Karachi (Pakistan), Kachchh, Okhamandal (India) and in Sri Lanka (Ali and Ripley 1983). The only record of its occurrence in Gujarat is from Mithapur (Dharmakumarsinhji 1972). On Mundra coast,

Kachchh, 5 pairs were incubating eggs and initiating nesting on April 17, 1986 (Taej Mundkur, *pers. comm.*, Naik *et al.* 1991). The present record confirms its occurrence at Porbander, where the possibility of its breeding cannot be ruled out.

During our visit in January and April, the whiskered tern and gullbilled tern were common, whereas the Caspian tern was seen occasionally. Our records of terns on Porbander coast support the view of Khacher (1996) that "our knowledge of terns, especially the migratory and more marine ones is comparatively meagre and more information is needed."

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16. RED-WINGED CRESTED CUCKOO *CLAMATOR COROMANDUS*, AN ADDITION TO THE AVIFAUNA OF ANAIMALAI HILLS (WESTERN GHATS) OF TAMIL NADU

Raghupathy Kannan's 'Avifauna of Anaimalai Hills. (*JBNHS 95(1)*: 193-214)' does not include the red-winged crested cuckoo (*Clamator coromandus*). I have recorded the species at Top Slip (Indira Gandhi Wildlife Sanctuary) in January 1996, in Erumai Pallam, close to the road leading to Parambikulam in the *Lantana camara* undergrowth. In February 1997, my friends Dr and Mrs Eric Lott had seen the bird in *Lantana camara* bushes in Karian Shola near the watch tower at Top Slip.

The species probably occurs in small numbers in this area. In January 1998, Dr. and Mrs. Eric Lott and I recorded a single bird in Periyar Wildlife Sanctuary, Kerala.

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17. COMPETITION BETWEEN JUNGLE MYNA *ACRIDOTHERES FUSCUS* AND LESSER GOLDEN BACKED WOODPECKER *DINOPIUM BENGHALENSE* FOR A NEST HOLE

A year long survey of a garden of about 675 sq. m, in a thickly populated area at south Kolkata (=Calcutta), showed the presence of 32 species of birds which were attracted to the garden for shelter, nesting ground and food (Jha *et al.* 1997). Recently, a series of events over a few days led me to write this note.

During the middle of April, 1998 while observing the birds in the garden, I noticed a hole in a coconut tree (*Cocos nucifera*), about 6.5 m above the ground (probably made by woodpeckers in the previous year) from which twigs and strips of plastic sheet were hanging out. It appeared that a pair of jungle myna (*Acridotheres fuscus*) had started building a nest a few days ago. The mynas collected and stocked nesting material for the following three days. To my surprise, on the fourth day I found some straw and plastic strips lying on the ground and saw the frontal part of a lesser golden backed woodpecker (*Dinopium benghalense*) jutting out of the hole. It appeared that the woodpeckers had captured the nest of the jungle mynas. The events that followed in the next few days were even more interesting. Quite often, I saw a pair of woodpeckers occupying the nest. During the early hours of the day or afternoon, whenever the jungle mynas returned to their nest, they were chased away by the woodpeckers. After their departure, the woodpeckers quickly entered the hole and established their rights on the territory. A few minutes later, the jungle mynas would return again to observe the woodpeckers and their nest from neighbouring trees. They repeatedly tried to re-enter the nest, but were vehemently opposed by the woodpeckers. These interactions continued for the next nine days.

One afternoon, I saw the climax of this fascinating drama. I found a large number of jungle mynas (about 25-30) screeching in the neighbouring trees. Suddenly, a few of them rushed inside the hole and forced the woodpecker out. In the meanwhile, a few mynas attacked the other woodpecker perched outside the nest, on the tree trunk. A fight ensued, and the woodpecker pair fell to the ground. The jungle mynas were so ferocious that it seemed as if they would kill the woodpeckers. The fighting continued for about 3-4 minutes, during which the harsh call of the jungle mynas filled the area. Suddenly, a small boy from the adjoining locality interfered in their fight with a stick. The fight stopped and the woodpeckers flew away. The jungle mynas too left the area.

The very next day, the hole was occupied by the jungle mynas again. In the following days I observed that they successfully nested, laid eggs, hatched chicks in the hole, and after completing their parental duties flew away with the two young ones. Interestingly, the woodpeckers were never seen anywhere near the trunk of that particular coconut tree again.

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18. FURTHER RECORDS OF *PYXIDEA MOUHOTII* (GRAY) FROM THE NORTH BANK OF R. BRAHMAPUTRA, ASSAM

The keeled box turtle *Pyxidea mouhotii* (Gray, 1862) is known from many localities of north-eastern India (Bhupathy and Choudhury 1992, Choudhury 1993, 1996a,b, 1998). Barring one (Drupong Reserve Forest), all the recorded sites were on the south bank of the river. The recorded localities were North Cachar Hills and Karbi Anglong (Choudhury 1993) of Assam, Khasi and Garo Hills of Meghalaya, Namdapha National Park and Mehao Wildlife Sanctuary in Arunachal Pradesh (Bhupathy and Choudhury 1992), Tamenglong district, Manipur (Choudhury 1996b), Hailakandi district in southern Assam, near the Assam-Mizoram interstate boundary (Choudhury 1998), and Drupong Reserve Forest, Papum Pare district, Arunachal Pradesh (Choudhury 1996a). The record from Drupong is the only one from the north bank of the Brahmaputra river. Outside India, the species has been recorded in Indochina from Myanmar to Vietnam and also Hainan in China (Stubbs 1991).

I report two recent records from the north bank of the Brahmaputra river. On July 22, 1998, a live turtle was caught by the forest staff near Potasali in Balipara Reserve Forest (26° 55' N, 92° 50' E), Sonitpur district, central Assam. The turtle was caught from the forest floor of the evergreen jungle, not far from the banks of the Jia-Bhoreli river, which forms the boundary of Nameri National Park. The terrain was flat, and the elevation *c.* 100 m above msl. I examined the specimen and then released it in Nameri National Park on July 31, 1998. It measured (in cm): straight line carapace length (SCL) 12.0; curved carapace length (CCL) 14.0; straight line carapace width (SCW) 9.5; curved carapace width (CCW) 13.5 and shell height *c.* 5.0; plastron length – greatest (PL–gt) 12.4; plastron length – notch to notch (PL–nn) 11.8; plastron width 7.5. Weight 200 gm.

On July 31, 1998, I obtained a carapace with plastron of the same species from a roadside hotel at Sessa in West Kameng district, Arunachal Pradesh. It was collected live near Sessa (27° 07' N, 92° 33' E) in Sessa Orchid Sanctuary in May-June 1998 and its flesh eaten. It was in the vicinity of wild banana trees near Sessa Nullah, but not near the water. The elevation of the place is about 1,000 m above msl, the maximum elevation record for the keeled box turtle in India so far. Measurements (in cm): SCL = 16.0 cm; CCL = 17.5; SCW = 11.6; CCW = 16.5; CH = *c.* 4.7; PL–gt = 14.3; PL–nn = 13.3; PW = 8.7. The plastron was conspicuously concave, indicating that it was a male.

The habitat in Sessa at around 1,000 m elevation is mostly tropical wet evergreen rainforest type, and the terrain mountainous, being part of the Eastern Himalaya. These records also extend the range of the species on the north bank by about 120 km westwards.

I would like to thank DFOs R.K. Das and M.K. Palit; Ratneswar Rai forest staff, Purna Bahadur Gurung of Sessa, Dr Anil Goswami and Bisoy Boro (driver).

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19. DISTRIBUTIONAL NOTES ON THE TURTLES OF WESTERN MYANMAR

At least 22 species of tortoises and freshwater turtles inhabit Myanmar, including six which are endemic (Iverson 1992, van Dijk 1997, Platt *et al.* 2000). However, the chelonian fauna of Myanmar is one of the least known in Asia (McCord 1997), and old fragmentary observations remain the principal source of information (Kuchling 1995, van Dijk 1997, Platt *et al.* 2000). Basic studies have not been undertaken and most distribution records originated prior to 1900 (van Dijk 1997). Species inventories of particular regions are essential for conservation, and acquiring baseline data on the occurrence even of common species is important (Dodd and Franz 1993, Oliver and Beattie 1993). We report recent distribution records of turtles in western Myanmar and discuss the significance of our findings.

Data on the occurrence of turtles in western Myanmar were gathered in conjunction with a tortoise survey of Shwe Settaw Wildlife Sanctuary (SSWS), conducted from August 3-24, 1999 (Platt 1999). SSWS (20° 11' N, 94° 28' E) was established in 1940 to protect Eld's deer (*Cervus eldi thamin)* (Salter and Sayer 1986). It is located on the western edge of the central dry zone within the rain shadow of the Arakan Yoma Mountains (FAO/UNDP 1982). Consequently, mean annual rainfall is low (*c.* 90 cm) with an extended dry season from December through May. Except for major rivers, there are no permanent streams, and available surface water is extremely limited during much of the year (FAO/UNDP 1982).

The dry zone is characterized by deciduous forest, locally known as *Indaing,* and dominated by fire-resistant trees such as *Dipterocarpus tuberculatus*, *Shorea oblongifolia*, *Pentacme siamensis* and *Tectona hamiltoniana*. Canopy height rarely exceeds 6 m, and the understorey consists of low shrubs and grass. Dense vegetation and stands of bamboo occur along ephemeral watercourses (FAO/UNDP 1982; Salter and Sayer 1986). Anthropogenic fires are common during the dry season (FAO/UNDP 1982; van Dijk 1994).

We interviewed SSWS personnel, villagers, hunters and turtle traders in the villages surrounding the sanctuary to obtain data on the turtle fauna of our study area. Local residents are generally an excellent source of information and shells are often sold to buyers who periodically visit the villages (Thirakhupt and van Dijk 1994). We measured carapace (CL) and plastron length (PL), and photographed available specimens. Voucher photographs were deposited in the Campbell Museum (CUSC), Clemson University, Clemson, South Carolina, USA. Taxonomy follows Ernst and Barbour (1989).

Cyclemys spp.

Three *Cyclemys* spp. were examined; two living turtles (CUSC 1797; CL = 19.4 cm, CUSC 1798; CL = 19.5 cm) and a carapace (CUSC 1770; CL = 20.4 cm). The specific identity of these specimens is not possible. *Cyclemys dentata* was reported from Myanmar (Iverson 1992). However, in a recent revision of the

genus, Fritz *et al.* (1997) contend that *C. dentata* actually represents a complex of cryptic species, and the nominal species occurring in Myanmar is *C. oldhamii*. Our specimens were obtained from a trader in Padan village, who was unsure of their origin. These turtles were probably collected in Rakhine State (formerly known as Arakan), where the occurrence of *Cyclemys* has been verified (Iverson 1992, Platt 2000). *Cyclemys* inhabit deep pools in permanent streams (Thirakhupt and van Dijk 1994, Sharma 1998), a habitat generally absent in the dry zone. The posterior neural and costal scutes of one living turtle were discoloured and fused with no evident sutures. Similar shell anomalies among *Terrapene carolina* were attributed to fire damage by Dodd *et al.* (1997).

Lissemys scutata

Approximately 15 *Lissemys scutata*, ranging in size from small juveniles to adults, were observed in an earthen pond (*c.* 0.25 ha) at a pagoda on Mya Kyaing Taung [=Emerald] Mountain (20° 16.76' N; 94° 29.01' E). Pagoda visitors probably released these turtles into the pond, a common practice at Buddhist temples. One turtle (CUSC 1766; CL = 13.8 cm) was captured for identification and released. Another adult appeared to be completely white, but we were unable to discern the eye colour and determine if the turtle was a true albino. Seven additional living *L. scutata* (CUSC 1767; CL = 16.0 to 18.8 cm) were obtained from a trader in Padan village. According to the trader, *L. scutata* is common in nearby rice fields, irrigation ditches and ponds. Our observations constitute the first records of *L. scutata* from this region of Myanmar (Iverson 1992, van Dijk 1993).

Manouria emys

We examined the carapace of an adult (CUSC 1764; CL = 44.2 cm) in Pyaw Bwe (20° 01.08' N, 94° 38.08' E), collected in May 1998 about 6.4 km southwest of the village. Villagers regard *M. emys* as extremely rare and that was the only specimen they had found in recent years. Residents of other villages that we visited had never encountered *M emys*. Given the dense human population and intensive hunting pressure (Platt 1999), few *M. emys* are believed to survive in this region. We also examined the plastron of an adult (CUSC 1765; PL = 35.0 cm) from Rakhine State at a trading establishment in Padan village. The plastron was uniformly dark in colour, with pectorals meeting at the midline, indicating the presence of subspecies *M. emys phayrei* in this region of Myanmar (Ernst and Barbour 1989). These specimens constitute the only recent records of *M. emys* from Myanmar. Theobald (1876) reported *M. emys* from Arakan (Rakhine) and Moulmain (Mawlamyaing). Earlier records are available from Tenasserim (Taninthayi) and the vicinity of Yangon (Iverson 1992). *M. emys* is regarded as rare and declining throughout most of its historic range (Moll 1989).

Melanochelys trijuga edeniana

Four shells of this endemic subspecies were examined; two in Padaung (CUSC 1772; CL = 20.7 cm and CUSC 1773; CL = 15.8 cm), and one each in Padan village (CUSC 1771; CL = 12.2 cm) and Laybin (CUSC 1774; CL = 14.2 cm). Carapaces were dark brown with lighter keels, plastrons were black with prominent yellowish margins. Additionally, van Dijk (1994) obtained a shell (CL = 16.7 cm) from an unspecified village near SSWS Headquarters. These specimens represent the first records from western Myanmar (Iverson 1992). According to SSWS rangers, *M. trijuga* inhabits intermittent streams and is active during the wet season.

Morenia ocellata

A carapace we photographed in Padan village (CUSC 1769; CL = 18.0 cm) constitutes the first record of *M. ocellata* from west central Myanmar. We also obtained a photograph (CUSC 1768) taken by U Hla Win (Deputy Director General; Department of Fisheries, *pers. comm.*), of two juveniles in a market at Sittwe, the only location west of the Ayeyarwady river where *M. ocellata* has been previously collected (Iverson 1992). The records available suggest that *M. ocellata* is restricted to southern Myanmar (Iverson 1992). However, Kuchling (1995) found at a market in southern China *M. ocellata* that appeared to have been collected locally, and speculated that these turtles may be more widespread than suggested by earlier records.

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20. DIFFERENCE IN BREEDING COLORATION IN *CALOTES VERSICOLOR* OF THE SOUTHERN AND NORTHERN ARAVALLIS IN RAJASTHAN

(*With one text-figure*)

During the breeding season, the male *Calotes versicolor* acquires a brilliant crimson or scarlet colour on the forehead and shoulder parts of the body towards dorsal and ventral sides, and black patches upon the neck, cheeks and throat (THE FAUNA OF BRITISH INDIA, Vol. 11, Smith 1935). During my field studies in the Aravalli hills, Rajasthan, I noticed a remarkable difference in the black patches of male *Calotes versicolor* at the northern and southern ends of the Aravalli range. Towards the extreme southern end in Udaipur district (23° 46' to 26° 2' N; 73° to 74° 35' E), in Phulwari Wildlife Sanctuary, forest areas of Jhadol, Ogna, Gogunda, Kotra, Khairwara and Udaipur Forest Ranges and the adjoining forests, individuals have black patches on their neck region, which just touch the swollen cheeks and at a distance from the tympanum (Fig. 1a). On the other hand, individuals confined to Nahargarh (26° 55'-27° 15' N' 75° 45'-76° E) and Jamwa Ramgarh Wildlife Sanctuaries, nearly 25 km away from

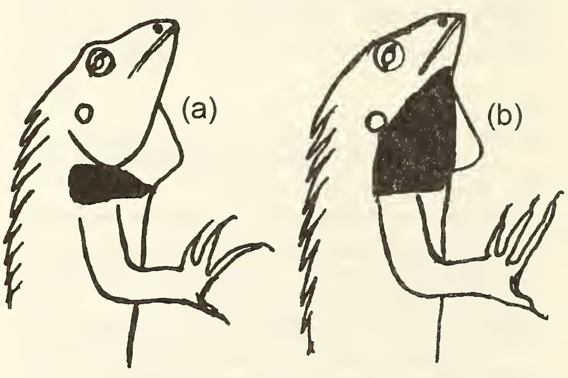

Fig. 1: (a) Black patch on the neck of Udaipur specimen. (b) Black patch on the neck of Jaipur specimen

Nahargarh towards the eastern side (27° 0'-27° 15' N and 76°-76° 15' E), in Jaipur district, towards northern Aravalli, have broader black patches, which extend to the swollen cheeks. Tapering black patches extend forward and terminate at the base of the lower jaw, below the

eyes. On the posterior, each patch touches the tympanum on both lateral sides (Fig. 1b).

Localities of Udaipur zone and Jaipur zone are nearly 500 km apart. The two ends of the Aravalli show different environmental conditions and forest types. The southern end, clad with broad-leaved deciduous forests receives higher rainfall (650-800 mm), while the northern end has dry deciduous and scrub forests and receives relatively low rainfall (400-600 mm).

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21. OCCURRENCE OF PAINTED KALOULA *KALOULA TAPROBANICA* (FAMILY MICROHYLIDAE) AT POINT CALIMERE, TAMIL NADU

On January 28, 2000, we heard frog calls on the outskirts of Kodikkadu village, near Point Calimere (10° 18' N and 79° 51' E), Tamil Nadu. The calls were coming from two temporary rain-water pools in the grassland, near some thorny bushes. The pools were separated by a bund with *Thespesia populnea* trees. Some of the roots of these trees were exposed, probably due to rain. While walking under these trees we saw a frog near one of the exposed roots, we caught and identified the species as the painted kaloula *Kaloula taprobanica*. When released on loose sand, it tried to sink into the soil, dislodging it by the sideways movements of its hind legs as described by Rajasingh 1972 (*JBNHS 69(1)*: 193). On being handled, it inflated its body like a toad.

In the Bombay Natural History Society's collection, there are two specimens collected by Dr. P.J. Sanjeeva Raj in 1966 from Tambaram. The present record is, therefore, a range extension.

Other amphibian species observed at Point Calimere were:

1. *Hoplobatrachus tigerinus*: Common, seen on the banks of temporary rainwater pools at night.
2. *Euphlyctis cyanophlyctis*: Common, mostly in rainwater pools. Most of them were heard calling at night. They were also seen in Muniappan, a large freshwater lake in this area.
3. *Tomopterna breviceps*: Seen crossing a sandy road in the jungle near Ramarpadam.
4. *Microhyla rubra*: Their calls were heard and the microhylids were seen in the grass near a temporary rainwater pool at the roadside at *c.*1845 hrs.

February 14, 2000

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22. ON THE DISTRIBUTION OF *ICHTHYOPHIS BOMBAYENSIS* TAYLOR, 1960 (FAMILY ICHTHYOPHIIDAE) IN CENTRAL WESTERN GHATS

Ichthyophis bombayensis Taylor 1960 was based on a unique type (BMNH 1888.6.11.2) collected by Gleadow from Surat, Gujarat. Since the original description, this species has been reported from the central Western Ghats (Balakrishna *et al.* 1982, Krishnamurthy and Katre 1993, Bhatta 1998, Pillai and Ravichandran 1999). However, while dealing with this species, Dutta (1997) has stated that "no other specimen of this species has been

collected after Taylor's description." Hence, to confirm its present distribution, one specimen of this species represented in the collection of the Southern Regional Station, Zoological Survey of India, Chennai and two in the collections of Kuvempu University, Karnataka (all collected from the Sringeri region of the central Western Ghats) were studied in detail. These specimens were also compared with related species, *I. malabarensis* and *I. peninsularis* sampled from the same locality to confirm its identification.

The morphometric details of the three species, *I. bombayensis*, *I. malabarensis* and *I. peninsularis* are compared in Table 1. The three

TABLE 1
MORPHOMETRY OF *ICHTHYOPHIS BOMBAYENSIS*, *I. MALABARENSIS* AND *I. PENINSULARIS* COLLECTED FROM THE SRINGERI REGION.
(all measurements are in mm)

Parameters	*I. bombayensis* KUES APODA 01 Loc. Sringeri	*I. malabarensis* VAG-9, ZSIM Loc. Sringeri	*I. peninsularis* VAG-25, ZSIM Loc. Neria
Total length	495.0	520.0	332.0
Tail length	19.0	19.5	12.0
Head Width	16.0	16.5	11.5
Snout length	11.0	10.0	7.3
Body Width	22.5	24.0	15.5
Eye to Tentacle	3.0	3.0	2.0
Tentacle to Nostril	6.0	6.0	4.0
Eye to Nostril	8.5	7.5	5.2
Eye to Eye	11.0	11.0	7.6
Snout tip to 1st groove	24.0	20.0	15.0
Snout tip to 2nd groove	30.0	24.5	19.3
Body folds	380.0	370.0	360.0
Tail folds	17.0	17.0	17.0
Premaxillary-maxillary	34-33	28-29	20-19
Prevomero-palatine	33-32	29-30	18-18
Dentary	26-26	26-27	19-19
Splenial	8-8	7-7	4-4

specimens of *I. bombayensis* collected from Sringeri agree with the original description by Taylor (1960). Hence, its occurrence in the central Western Ghats (75° 15' 14" N, 13° 25' 05" E), at a distance of 900 km from the type locality, is confirmed.

Specimens examined: Regn No. KUES, APODA-1 [Kuvempu University, Environmental Science] *I. bombayensis*, Sringeri, Karnataka, 10.viii.1999, coll. S.V. Krishnamurthy; Regn No. VAG 12 ZSIM [Zoological Survey of India, Southern Regional Station, Madras(=Chennai)] *I. bombayensis*, Sringeri, Karnataka, 5.i.1994, coll. R.S. Pillai; Regn No. VAG 9 ZSIM *I. malabarensis*, Sringeri, Karnataka, 4.i.1994, Coll. R.S. Pillai; Regn No. VAG 25 ZSIM. *I. peninsularis*, Neria, Karnataka, 4.vii.1992, coll. B.K. Sharath.

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23. NINE NEW RECORDS OF AMPHIBIA (ANURA) FROM ARUNACHAL PRADESH, INDIA

Arunachal Pradesh in the Eastern Himalaya is one of the 18 global hotspots of biodiversity (Myers 1988). Amphibian habitats of East Kameng (26° 56'-27° 43' 30" N, 92° 36'-93° 24' E) and West Kameng (26° 55'-27° 57' N, 92°-93° 15' E) districts in western Arunachal Pradesh were surveyed during 1997-99. West Kameng district has an area of 7,422 sq. km, with an annual precipitation of 1,709 mm at Bomdila (2,938 m above msl). East Kameng district covers 4,134 sq. km, with an annual precipitation of 2,212 mm at Seppa (2,317 m above msl).

The area is covered with mostly tropical and subtropical moist evergreen forests, with perennial torrential streams and rivers.

Amphibian surveys of Arunachal Pradesh are limited to the work of Annandale (1912) who reported amphibians from Siang district. Sarkar and Sanyal (1985) reported 14 species from Namdapha National Park. Chanda (1994) reported 22 species from Arunachal Pradesh. Bordoloi and Borah (1999) made a new record of a frog (*Hoplobatrachus crassus*) from Arunachal Pradesh and Assam, northeast India.

Amphibian habitats were visited during the day and at night. Tadpoles were collected and identified during the day, while adults were recorded at night. Due to restrictions on collection, toads and frogs were identified and released. Only when field identification was not possible, one or two specimens were retained. These were preserved in 8% formalin and their morphometric data recorded.

Literature and material in the collections of the Bombay Natural History Society, Mumbai and Zoological Survey of India, Kolkata, were consulted for identification. A total of 20 species representing 5 families and 13 genera were recorded. Specimens have been deposited at the State Forest Research Institute, Arunachal Pradesh.

Class: Amphibia
Order: Anura
Family: Megophryidae
Genus (1) *Megophrys* Kuhl & Van Hasselt, 1822

1. ***Megophrys parva*** (Boulenger, 1893)
Specimen No. State Forest Research Institute (SFRI) V/A 2328

Locality: Sessa, Altitude 1,708 m above msl.

Remarks: New record from Arunachal Pradesh.

One adult male specimen was collected near Sessa Orchid Sanctuary from a branch overhanging a stream. It was also recorded from Pakhui Wildlife Sanctuary, Bhalukpung and Tenga Valley.

2. ***Megophrys lateralis*** (Anderson, 1871)
Specimen No. SFRI V/A 2330

Locality: Pakhui, Altitude 216.7 m above msl.

Remarks: New record from Arunachal

Pradesh. Also recorded from Sessa, Pakhui and Tippi. Earlier recorded only from Assam. Specimen collected from tree trunk.

Family: Bufonidae

Genus (2) *Bufo* Laurenti, 1868

3. ***Bufo melanostictus*** Schneider, 1799

Specimen No. SFRI V/A 2324

Locality: Widely distributed in both districts.

Remarks: Recorded from all localities surveyed, throughout the year. Breeding population was recorded from Tippi in December, the driest and coldest month of the year. (Precipitation 13.40 mm, Temperature max. 27 °C, min. 8.5 °C)

Family: Microhylidae

Genus (3) *Microhyla* Tschudi, 1838

4. ***Microhyla ornata***

(Duméril & Bibron, 1841)

Specimen No. SFRI V/A 2322

Remarks: New record from Arunachal Pradesh. Sighted at Bhalukpung, Khari, Sejusa and Tippi up to of 1,200 m above msl.

Genus (4) *Uperodon* Duméril & Bibron, 1841

5. ***Uperodon globulosus*** (Günther, 1864)

Specimen No. SFRI V/A 2331

Remarks: New record from Arunachal Pradesh, Pakhui Wildlife Sanctuary, Bhalukpung, Tippi and near Khari river. A burrowing species.

Family: Rhacophoridae

Genus (5) *Chirixalus* Boulenger, 1890

6. ***Chirixalus vittatus*** (Boulenger, 1887)

Specimen No. SFRI V/A 2332, 2333

Remarks: New record from Arunachal Pradesh. Specimen compared with the description in Khare and Kiyasetuo (1986). Specimen collected from vegetation near waterbody from Tippi. Also recorded from Bhalukpung, Sejusa, Sessa and Pakhui Wildlife Sanctuary.

Genus (6) *Polypedates* Tschudi, 1838

7. ***Polypedates leucomystax***

Gravenhorst, 1829

Specimen No. SFRI V/A 2320

Remarks: This species is widely distributed in both districts. Mostly collected from shrubs, logs and stones near aquatic habitats.

8. ***Polypedates maculatus*** (Gray, 1834)

Specimen No. SFRI V/A 2334

Remarks: New record from East and West Kameng. Less abundant than *P. leucomystax*. Found in the same habitat as *P. leucomystax*, up to 1,200 m above msl. In both disturbed and virgin forest.

Genus (7) *Rhacophorus* Kuhl & Van Hasselt, 1822

9. ***Rhacophorus maximus*** Günther, 1858

Specimen No. SFRI V/A 2321

Remarks: A common Rhacophorid, found in trees and shrubs near aquatic habitats in most of the areas surveyed. Live coloration, light blue and bluish-green. Foam nests found on leaves and branches overhanging waterbodies.

Family Ranidae

Genus (8) *Amolops* Cope, 1865

10. ***Amolops formosus*** (Günther, 1875)

Specimen No. SFRI V/A 2327

Remarks: New record from Arunachal Pradesh. Widely distributed in both districts. Collected from streams.

11. ***Amolops gerbillus*** (Annandale, 1912)

Specimen No. SFRI V/A 2338

Remarks: Earlier recorded from eastern Arunachal Pradesh. New record from West Kameng district. Collected from a stream near Sessa Orchid Sanctuary.

Genus (9) *Euphlyctis* Fitzinger, 1843

12. ***Euphlyctis cyanophlyctis*** (Schneider, 1799)

Specimen No. SFRI V/A 2316

Remarks: Widely distributed in both the districts. Recorded up to 2,743 m above msl in disturbed and undisturbed habitats throughout the year.

Genus (10) *Hoplobatrachus* Peters, 1863

13. ***Hoplobatrachus crassus*** (Jerdon, 1853)

Specimen No. SFRI V/A 2318

Remarks: Recorded for the first time in western Arunachal Pradesh. It inhabits low altitude areas such as Tippi and Bhalukpung.

14. ***Hoplobatrachus tigerinus*** (Daudin, 1803)

Specimen No. SFRI V/A 2319

Remarks: Though distributed throughout India, it was not reported from Arunachal Pradesh. Common at low altitudes, sharing the habitat with other common frogs such as *H. crassus* and *E. cyanophlyctis*. During this survey, it was recorded from Tippi, Bhalukpong, Pakhui Wildlife Sanctuary and paddy fields near Bharali river.

Genus (11) *Limnonectes* Fitzinger, 1843

15. ***Limnonectes laticeps*** Boulenger, 1882

Specimen No. SFRI V/A 2339

Remarks: First record from Arunachal Pradesh. Found buried in sand under stones, leaves and twigs. Recorded from Tippi, Bhalukpung, Pakhui, Sessa and Bharali river.

16. ***Limnonectes limnocharis*** (Boie in: Wiegman, 1835)

Specimen No. SFRI V/A 2317

Remarks: Widely distributed in both the districts, at all altitudes. Found near human habitation and in wetlands within undisturbed forests.

Genus (12) *Paa* Dubois, 1975

17. ***Paa liebigii*** (Günther, 1860)

Specimen No. SFRI V/A 2336

Remarks: New record from western Arunachal Pradesh. This frog has been recorded from pools with low temperatures from 2,743 m above msl.

Genus (13) *Rana* Linnaeus, 1758

18. ***Rana danieli*** Pillai & Chanda, 1977

Specimen No. SFRI V/A 2329

Remarks: Earlier reported from Namdapha. During the present survey, it was recorded from the western districts. Tadpoles were collected from stagnant habitats shared by other common species such as *E. cyanophlyctis* and *L. limnocharis*.

19. ***Rana erythraea*** (Schlegel, 1837)

Specimen No. SFRI V/A 2337

Remarks: New record from Arunachal Pradesh. Common in the eastern and western part of the state at low altitudes. Recorded from the banks of Bharali river, Tippi, Bhalukpung, etc.

20. ***Rana taipehensi*** Van Denburgh, 1909

Specimen No. SFRI V/A 2326

Remarks: First record from Arunachal Pradesh. Common at low altitudes. Recorded from paddy fields.

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24. NEW RECORD OF *SAURIDA WANESIO* SHINDO & YAMADA, (OSTEICHTHYES: MYCTOPHIFORMES: SYNODIDAE*) FROM THE WEST BENGAL COAST, WITH A NOTE ON *LUTJANUS SANGUINEUS* (CUVIER) (OSTEICHTHYES : PERCIFORMES : LUTJANIDAE)

One specimen of *Saurida wanesio* Shindo & Yamada and two of *Lutjanus sanguineus* (Cuvier) were collected from a mini trawler, at the fish landing point in Maohana, Digha, West Bengal (21° 36' N, 87° 30' E), on November 26, 1996.

This is the first catch of *Saurida wanesio* from the West Bengal coast. Fischer and Whitehead (1974) noted its occurrence only in South and East China seas. Dutt and Sagar (1981), however, reported the species from Karwar, on the west coast of India. Talwar and Kacker (1984) also support the views of Dutt and Sagar (1981). Talwar *et al.* (1992) did not include the species in the FAUNA OF WEST BENGAL.

Hence, the present collection of *S. wanesio* is the first record from the West Bengal coast, and probably a new record from the east Indian waters.

Occurrence of *Lutjanus sanguineus* (Cuvier) in the coastal waters of West Bengal has been reported by Misra (1959) and its distribution in the northeastern part of the Indian Ocean is mentioned by Fischer and Whitehead (1974), but Talwar *et al.* (1992) criticised these records as they are not based on material collected from the area.

Talwar *et al.* (op. cit.), therefore, did not include the species in the Fauna of West Bengal. The present report of the species *L. sanguineus* in the coastal waters of West Bengal, based on two specimens, supports the views of Misra (op. cit.), and Fischer and Whitehead (op. cit.).

We are grateful to the Director, Zoological Survey of India for permission to carry out the work.

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25. ON THE OCCURRENCE OF *NEMACHEILUS KERALENSIS* (RITA *ET AL.*) IN MUVATTUPUZHA RIVER, KERALA, INDIA

Oreonectes (*Indoreonectes*) *keralensis* (= *Nemacheilus keralensis*) was described from Pampadumpara area of the Periyar river, south Kerala (Rita *et al.* 1978). The fish has very narrow, ill-defined vertical bands from dorsal to ventral surface, often split below the lateral line into several streaks or spots, a black mark at dorsal fin origin and a narrow stripe, or two spots on base of caudal fin. It is endemic to Kerala (Talwar and Jhingran 1991, Jayaram 1999), recorded only from the high altitude areas of the Periyar river. Raju Thomas *et al.* (1999) recorded it from the Eravikulam National Park.

During our survey of the fish fauna of the Western Ghats in Kerala, we collected eight specimens of *Nemacheilus keralensis* from the Kaitapara area of Kaliyar tributary in the Muvattupuzha river (Idukki district). The water temperature at the collection sites was 16-21 °C, which may be crucial to its survival. While sampling, the velocity of the water was 32-41 cm/sec. The stream was very small, 3-4 m wide and 15-20 cm deep. Gravel, cobblestones and rock were the major components of the substrate at the collection site. The water was clear (DO value = 6.5-7 ppm).

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26. FISHES OF RAMANADHI RIVER IN KALAKKAD MUNDANTHURAI TIGER RESERVE, TAMIL NADU, INDIA

Fish survey was carried out as a part of a research programme on the fish habitats and communities in Tamiraparani river basin of Western Ghats. Ramanadhi river has two tributaries which are dammed upstream. There are six man-made canals and 32 associated wetlands to form a sub-basin of the major Tamiraparani river basin. This is the first report on fishes from Ramanadhi in Kalakkad Mundanthurai Tiger Reserve. Species recorded in the present work have already been recorded by earlier workers Johnsingh and Wickram (1987), Rema Devi *et al.* (1997), Arunachalam *et al.* (1997), Arunachalam and Sankaranarayanan (1998a, b) Arunachalam and Johnson (in press) and Arunachalam (2000) in Tamiraparani river and its sub-basins.

Ramanadhi river takes its origin in the eastern slopes of the Western Ghats at 1,572 m above msl (8° 50' 45" N, 77° 19' 15" E). After flowing about 8 km along the eastern slopes of the Western Ghats, through thickly wooded forests, it emerges on the plains on the north-eastern side of Melakadayam village, Ambasamudram taluka, Tirunelveli district. After flowing another 7 km, it is joined by the Jambunadhi river and (now Veeranathi), flows through the plains for 12 km. It meets Gadana river to the northeast of Kila Ambur village in Ambasamudram taluka. The average rainfall is 183 mm (data of Public Works Department, Govt. of Tamil Nadu).

Fishes were collected from upstream, downstream and some associated wetlands using drag nets, monofilament gill nets and scoop nets. Colour, spots and other characters were noted and the specimens were then preserved in 10% formaline. Standard literature was referred for identification.

We recorded 25 species belonging to 18 genera and 10 families, representing 4 orders, (Table 1). All the species are known from Tamiraparani river and its sub-basins (Rema Devi *et al.* 1997, Arunachalam 1998)

TABLE 1
FISH SPECIES RECORDED IN RAMANADHI RIVER AND ITS ASSOCIATED WETLANDS

Species	Status
I ORDER: CYPRINIFORMES	
i) Family: Cyprinidae	
a) Genus: *Puntius*	
1. *Puntius amphibius*	n.a.
2. *Puntius arenatus*	n.a.
3. *Puntius bimaculatus*	n.a.
4. *Puntius dorsalis*	En
5. *Puntius sarana subnasutus*	n.a.
6. *Puntius sophore*	LRnt
b) Genus: *Salmostoma*	
7. *Salmostoma clupeoides*	LRlc
c) Genus: *Amblypharyngodon*	
8. *Amblypharyngodon microlepis*	n.a.
d) Genus: *Danio*	
9. *Danio aequipinnatus*	LRnt
e) Genus: *Esomus*	
10. *Esomus thermoicos*	n.a.
f) Genus: *Parluciosoma*	
11. *Parluciosoma daniconius*	LRnt
g) Genus: *Garra*	
12. *Garra mullya*	n.a.
ii. Family: Balitoridae	
h) Genus: *Bhavania*	
13. *Bhavania australis*	En
i) Genus: *Nemacheilus*	
14. *Nemacheilus triangularis*	LRlc
iii) Family: Cobitidae	
j) Genus: *Lepidocephalus*	
15. *Lepidocephalus thermalis*	n.a.
2. ORDER: SILURIFORMES	
iv. Family: Bagridae	
k) Genus: *Mystus*	
16. *Mystus armatus*	n.a.
v. Family: Heteropneustidae	
l) Genus: *Heteropneustes*	
17. *Heteropneustes fossilis*	Vu

TABLE 1 (contd.)
FISH SPECIES RECORDED IN RAMANADHI RIVER AND ITS ASSOCIATED WETLANDS

Species	Status
3. ORDER: CYPRINODONTIFORMES	
vi. Family: Aplocheilidae	
m) Genus: *Aplocheilus*	
18. *Aplocheilus lineatus*	n.a.
4. ORDER: PERCIFORMES	
vii. Family: Ambassidae	
n) Genus: *Pseudambassis*	
19. *Pseudambassis ranga*	n.a.
viii. Family: Cichlidae	
o) Genus: *Etroplus*	
20. *Etroplus maculatus*	n.a.
p) Genus: *Oreochromis*	
21. *Oreochromis mossambica*	Exotic
ix. Family: Gobidae	
q) Genus: *Glossogobius*	
22. *Glossogobius giuris*	LRnt
x. Family: Belontiidae	
r) Genus: *Macropodus*	
23. *Macropodus cupanus*	n.a.
xi. Family: Channidae	
s) Genus: *Channa*	
24. *Channa marulius*	LRnt
xii. Family: Mastacembelidae	
t) Genus: *Mastacembelus*	
25. *Mastacembelus armatus*	n.a.

n.a. - not assessed; LRnt - Lower Risk, near threatened; Vu - vulnerable; LRlc - Lower Risk, least concern; En - Endangered

The headwaters and the lowlands of Ramanadhi river are highly disturbed as the riparian forests are replaced by coconut and teak plantations by private owners inside the forest reserve area. Introduction of the exotic cichlid fish *Oreochromis mossambica* also threatens the fish fauna in the lowland.

We could not observe a single specimen of *Puntius arulius tambiraparniei* in the Ramanadhi, though this endemic species is recorded in streams and rivers of Tamiraparani, Manimuthar, Servalar, Gadana and Chittar river basins (Rema Devi *et al.* 1997, Arunachalam *et al.* 1997, Arunachalam, 1998).

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27. MIGRATION OF BLUE MORMON BUTTERFLY *PAPILIO POLYMNESTER* IN MUMBAI (MAHARASHTRA)

The presence of the Blue Mormon butterfly *Papilio polymnester* in and around Mumbai was recorded by W.F. Melvin at Sewree in March 1889 and A.E.G. Best (1951) at Tulsi lake. D.E. Reuben had observed them in 1960-62 and suggested that this butterfly appears seasonally in the Pali Hill (Bandra) area. Serrao (1978) observed a Blue Mormon flying east to west on September 23, 1970. He recorded a number of individuals flying in the same direction till end October, 1970. He also observed many Blue Mormons feeding on flowers till March 1971 in the Tulsi lake environs.

Haribal (1986) recorded a few sightings of these butterflies at the Indian Institute of Technology, Powai, Mumbai every year from 1978 to 1982. However, in all these sightings, they did not appear to be flying in any particular direction, except near Matunga station, where the butterfly was definitely flying westwards.

The first author (NC) saw them at Goregaon, Mumbai on September 15, 1999 around noon. The flight was rapid, at 30 m above ground level, and was westwards. A similar observation was made on September 18, 1999.

Interestingly, the second author (VH) has seen another live specimen at Hornbill House, Colaba, Mumbai on September 22, 1999, flying east to west. Earlier, this species was observed by the first author (NC) at Goregaon on August 28, 1995. A female Blue Mormon was sighted at Khar (Mumbai) in the first week of September (Isaac Kehimkar *pers. comm.*). The butterfly laid eggs on a *Citrus* plant.

From these observations, it is evident that the Blue Mormon is a seasonal migrant, and arrives in Mumbai during late August to September. As it is usually found in hilly regions around 350 m above msl, with heavy rainfall, it is possible that migration depends on good rainfall in Mumbai during August and September.

October 18, 1999

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28. FORMS OF *DANAUS CHRYSIPPUS* LINN. (LEPIDOPTERA: NYMPHALIDAE) IN THE KUMAON HIMALAYA

The Plain Tiger, *Danaus chrysippus* Linn., is one of the commonest Indian butterflies, found throughout the plains, in degraded areas, semi-arid regions and even urban areas. It is not common in evergreen rainforest, and though it ascends to an elevation of 2,750 m in the Himalaya, it is not as common in the hills as on the plains.

Four forms of this butterfly occur in India. The typical form *chrysippus* Linn. is common everywhere. The form *alcippoides* Moore has most of the hindwing recto white. The form *amplifascia* Talbot has white spots of the pre-apical band on the forewing recto extending inwards to the discocellulars, while the form *dorippus* Klug lacks the white spotted black apex to the forewing recto. The three last forms have been recorded sporadically in India, although *dorippus* is the commonest or dominant form in parts of Africa, where *D. chrysippus* is widespread.

The form *dorippus* was thought to occur west of what is now Pakistan (Marshall & de Niceville 1883, quoted by Donahue 1962), but it has subsequently been recorded from Sri Lanka (Woodhouse and Henry 1942), Bengal (Best 1954), Bihar (Harman 1950), Rajasthan (Donahue 1962), Delhi (Ashton 1972), near Pune in Maharashtra (editorial note following Best 1954) and the submontane tract or Bhabar of Kumaon and Garhwal (Atkinson 1882). The record by Atkinson, who treated *dorippus* as a distinct species, is not entirely reliable. Though he asserted that his list was compiled on the basis of actual captures, an unusually large proportion of "records" have not been seen since and are probably misidentifications.

A female specimen of *dorippus* in good condition was recorded from Jones Estate near Bhimtal in Nainital district, Kumaon Himalaya at *c.*1,500 m on May 9, 1994. It has a forewing length of 36 mm, and is in my collection.

No previous or subsequent individuals of this form have been noted in the area. This is not unusual, since it is known to occur in drier regions (Wynter-Blyth 1957) and has hitherto not been recorded in the hills in India. Its appearance in the hills in a region of rather heavy rainfall (up to 2,000 mm annually) is very unusual.

However, April, May and part of June are generally very hot and dry, with the temperature touching 34 °C in the shade, even at 1,500 m in the Bhimtal valley, and 1994 was no exception, which might account for the presence of *dorippus* here.

The form *alcippoides* was considered "very rare" by Wynter-Blyth (*op. cit.*) as well as Evans (1932). There is a female specimen from Dehra Dun in the collection of the Forest Research Institute, Dehra Dun (Roonwal *et al.* 1963) which appears to be the only known specimen from this area. A specimen of *D. chrysippus* with white streaks along the veins of the hindwing recto, recorded on May 15, 1975 in the same locality, i.e., Bhimtal valley, is in my collection. This specimen is an intermediate between typical *chrysippus* and *alcippoides*. Having recorded this intermediate form, it is not unlikely that true *alcippoides* will turn up in the Bhimtal valley sooner or later.

Larsen (1987) noted that the form with the white hindwings (*alcippoides*) became the predominant form in Malaysia and North Sumatra during the 20th century. It would be interesting to keep a check on *D. chrysippus* populations in India, to see whether the effects of the factors influencing the structure of the populations in southeast Asia extend as far as India, in which case *alcippoides* should begin

to appear more frequently. If this is not so, the three uncommon forms will continue to be as rare on the Subcontinent as they have been in the past.

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29. ON THE DISTRIBUTION OF SATURNID MOTHS *SONTHONNAXIA MAENAS* (DOUBLEDAY) AND *LOEPA KATINKA* (WESTWOOD)

While working on an Environmental Impact Assessment project at Kudremukh National Park (KNP), Mr. S.A. Hussain recorded two Saturnid moths, which were photographed by his colleagues and brought for identification. The moths were identified as *Sonthonnaxia maenas* (Doubleday) (syn. *Actias maenas*) and *Loepa katinka* (Westwood).

According to Arora & Gupta (Memoirs of the Zoological Survey of India, Vol. 16, Part I, 1979), the distribution of the moths *Sonthonnaxia maenas* and *Loepa katinka* is northeast India (Assam, Meghalaya, Arunachal Pradesh), Sikkim and West Bengal. *S. maenas* is reported from South Andamans, while *L. katinka* is also found in Himachal Pradesh, Uttar Pradesh and Tamil Nadu. The present record of these species from Kudremukh National Park (KNP), Karnataka is an extension in their distribution range, it is interesting to note that both the species are mainly found in the foothills of the Himalaya and areas of heavy rainfall like south Andaman and places in Tamil Nadu. Their occurrence in the KNP shows the geographical link in the faunal distribution.

Loepa katinka is also found in other parts of Karnataka. It has been photographed in Matheran (Maharashtra). (I. Kehimkar *pers. comm.*)

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30. REDESCRIPTION OF *SCHIZOMUS BUXTONI* GRAVELY FROM SRI LANKA ON THE BASIS OF SYNTYPES DEPOSITED IN THE ZOOLOGICAL SURVEY OF INDIA, CALCUTTA BY F.H. GRAVELY 1915

(*With sixteen text-figures*)

Schizomids are minute arachnids difficult to see with the naked eye. They are nocturnal and secretive in habit, and a difficult group to collect and study. There are about 5-6 species described from India (Bastawade 1985, 1992), 8 from Sri Lanka and 3 from Myanmar in the Oriental region. In 1872, Pickard-Cambridge described *Schizomus crassicaudatus*, the first species known from Sri Lanka. Subsequently, Pocock (1900) described *S. suboculatus*, Gravely (1911a, 1911b, 1912, 1915) described 5 species *S. buxtoni*, *S. greeni*, *S. peradensis*, *S. vittatus* and *S. perplexus*, and Fernando (1957) described *S. formicoides*.

The species described by Gravely (1911-1915) were from his own collections of several male and female specimens from various localities in Sri Lanka. He designated these collections as SYNTYPES and deposited them at the Zoological Survey of India, Calcutta (=Kolkata).

I had the opportunity to study a few specimens of *S. buxtoni* Gravely and to prepare redescriptions and illustrations, which would facilitate future studies on this small, but most interesting invertebrate.

Schizomus buxtoni Gravely
(Figs 1-16)

1915. *Schizomus (Trithyreus) buxtoni*, Gravely, *Rec. Indian Mus. 11*: 383-6.

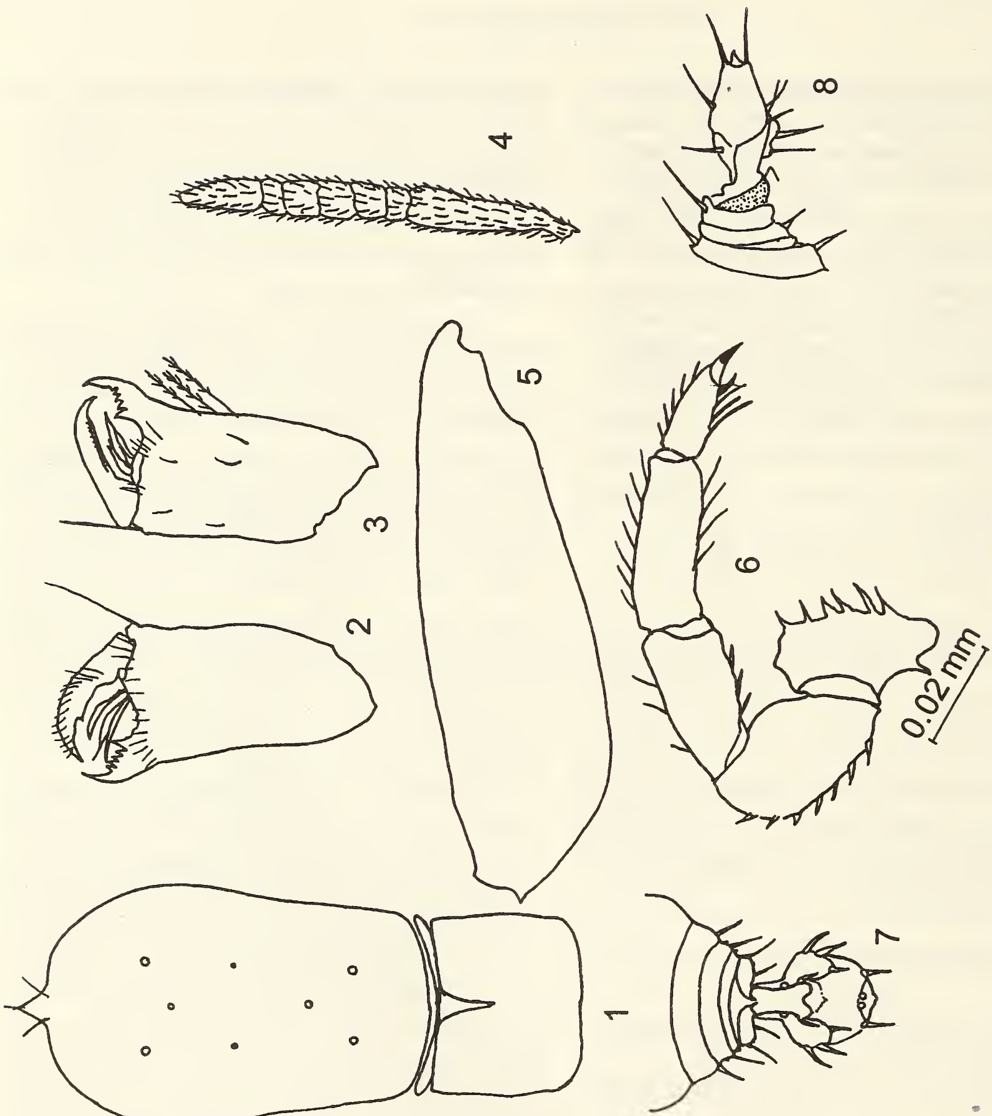
General: Body colour yellowish-brown, darker on pedipalps and cheliceral fingers, but pale on distal digits of legs; sometimes with a greenish tinge on larger specimens (Gravely 1915). Dorsal body surface smooth on most of the anterior portions of propeltidium, but rough with microscopic suturous reticulation on posterior portion. Pedipalps short and stout, not much expanded and produced on trochanters (Figs 6 & 10); male flagellum with a ventral longitudinal hyaline body (Figs 7 & 8).

Measurements (in mm): Female syntype, total length 4.86, cephalothorax 1.78 long, 1.008 wide; abdomen 3.08 long.

Cephalothorax: Propeltidium more than twice as long as wide, anterior margin acutely narrowed in a median process bearing a median seta, followed immediately by a pair of setae and subsequently with three lateral and two median pairs of setae (Fig. 1), eye spots absent, posterior portion rough with microscopic suturous reticulations; mesopeltidium much narrowed, not clearly seen; metapeltidium bearing a deep median notch on anterior portion (Fig. 1), with a pair of posterior setae. Anterior sternum with 8-9 setae plus a pair of long sternapophyseal setae from anterior margin, posterior sternum weakly sclerotised, bearing 5-6 setae.

Abdomen: All tergites and sternites smooth, sternite I with two anterior rows of 8 setae and a pair of lateral oblique rows of 7 setae (Fig. 13), sternite II-IX with a pair of lateral, 1 submedian lateral and 1 pair of anterior median setae each; setation on X-XII segments not clear. Tergites I-VII smooth, with a pair of median setae and tergites VIII-IX with a pair of median and lateral setae. Segment XII with only 4 dorsal setae clearly noticeable. Flagellum 0.342 mm long, most of the setae shaded or drooped (due to prolonged preservation) as in Fig. 14. Spermathecae with two pairs of spearheaded lobes, with undulating inner surface (Figs 15 & 16).

Chelicerae: Basal segment smooth, slightly depressed medially, fixed finger with



Figs 1-8: *Schizomus buxtoni* Gravely ♂.
1. Cephalothorax, dorsal aspect; 2. Chelicera, promarginal aspect; 3. Chelicera, retromarginal aspect;
4. Tarsus, metatarsus I, dorsal aspect; 5. Femur IV, lateral aspect; 6. Palp, dorsal aspect;
7. Abdominal Segments IX-XII with flagellum, ventral aspect; 8. Segments X-XII for flagellum, lateral aspect.

4 minute teeth between two large outer teeth (Figs 2 & 3), movable finger with smooth serrula, with 12-13 minute teeth ridge and a tooth on lateral anterior margin (Figs 2 & 3), types of setae present Type I-3, II-4, III-7, IV-4, V-3 and VI-1.

Pedipalps: Short and stout, trochanter produced, but not acutely, bearing 6-7 spinose setae, femora rounded and anteroventrally knobbed with spines on exterior surface, patellae without spur, but with long pilose setae on ventromesal margins, a pair of longer plumose setae on distal end, tibiae not rounded, but almost pentagonal with many setae on dorsal and mesal surfaces, with a long seta on ventromesal surface, tarsus-basitarsus with several short and some long plumose setae, spur about 0.6 and claws about 1.2 times dorsal length of tarsus-basitarsus.

Legs: Leg I-IV as in Table 1, basitarsal-tarsal proportions as 22:3:4:4:5:5:13 (Fig. 4). Femora IV about 3.3 times long as deep.

Measurements (in mm): Male syntype total length 3.96, cephalothorax 1.88 long, 1.00 wide; abdomen 2.08 long.

Cephalothorax: Propeltidium 1.28, almost same as in female syntype, except 2 median and 2 lateral setae; mesopeltidium not very clear and very narrow, thus invisible, transparent due to long preservation; metapeltidium deeply notched medially (Fig. 9).

Abdomen: Tergites I-V each with a pair of median setae, tergites VI-VIII each with a median pair and a lateral pair of setae, tergite IX less than half the length of tergite VIII and with a pair of median and two lateral pairs of setae. Segments X-XII telescoped, X with one mediolateral, 2 pairs of lateral setae; XI with 6-8 ventral setae, dorsal setae not clear; XII with 2 pairs of strong dorsomedians, 2 pairs of short and stout laterals and 6 ventral setae. Male flagellum short, 0.414 long, and 0.27 wide, sphere shaped, knobbed with two lateral lobes, not much sclerotized and provided with a ventromedian, elongated along with ventral median line a semi-dumbbell shaped transparent hyaline piece (Figs 7 & 8), with 2d, 2dm, 2L and 3V setae. **Legs**: I-IV as in Table 2, basitarsal-tarsal proportions as 27:4:5:6:5:4:15 (Fig. 12), Femora IV 2.6 times as long as deep (Fig.11), anterior sternum with 7 setae and a pair of long sternapophysial setae on anterior margin, posterior sternum with 5-6 setae.

Material examined: 1 ♀, 1 ♂, from the type series deposited at National Zoological Collections, Zoological Survey of India, Calcutta (=Kolkata).

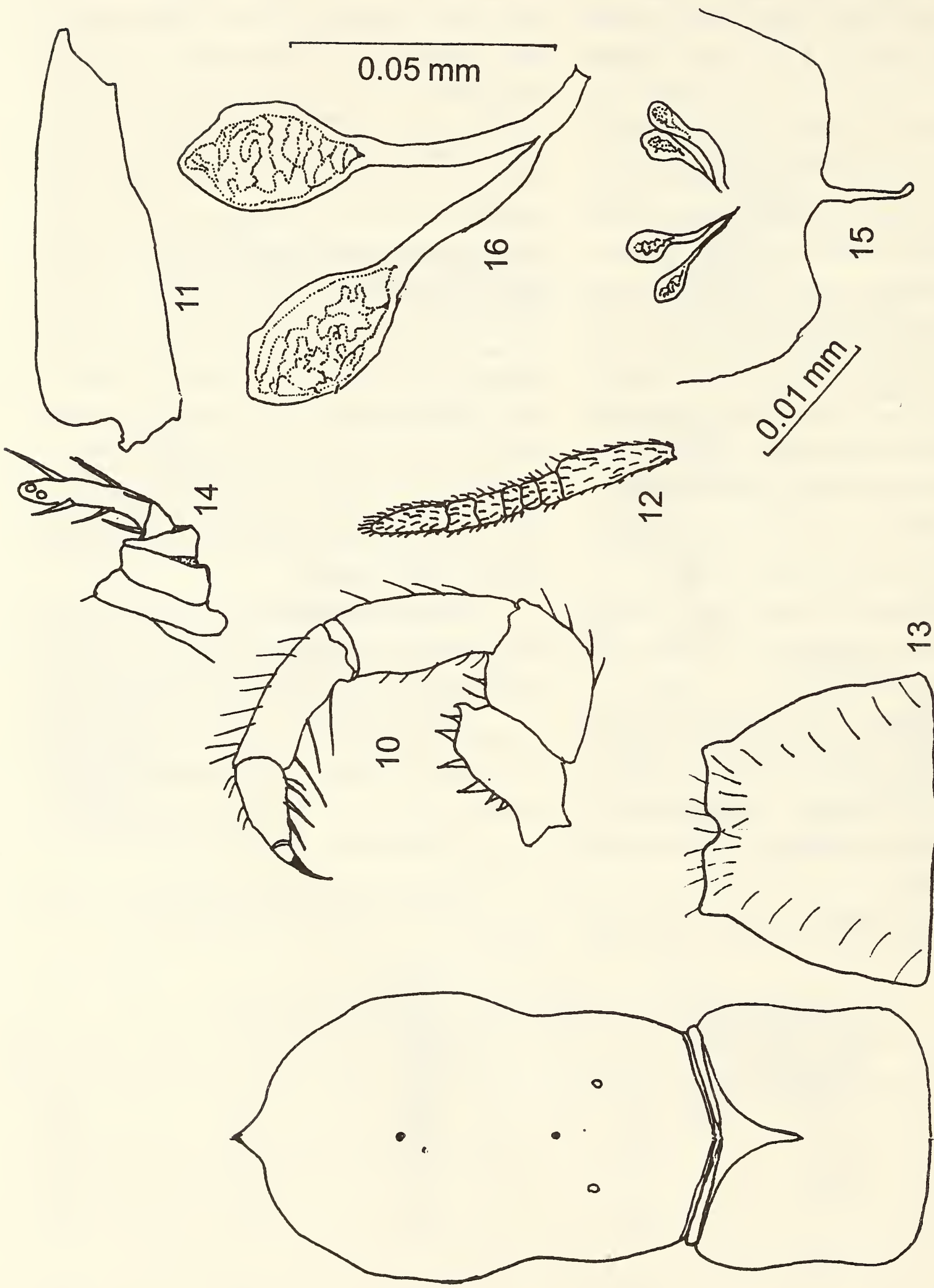
Type Locality: i. Polonuruwa, North central Province, Sri Lanka (Ceylon), several ♀♀ and ♂♂ collected from under rocks and leaves.

ii. Minneriya, North Central Province 3 ♀♀.

iii. Sigiri, Central Province many ♀♀ and ♂♂.

TABLE 1
MEASUREMENTS (IN MM): FEMALE SYNTYPE *S. BUXTONI* GRAVELY

	Pedipalp	Legs I	II	III	IV
Coxa	0.67	0.51	0.52	0.36	0.36
Trochanter	0.34	0.36	0.36	0.23	0.27
Femur	0.43	1.10	1.08	0.99	1.22
Patella	0.54	1.39	0.54	0.32	0.34
Tibia	0.47	1.12	0.52	0.38	0.81
Tarsus		0.40	0.34	0.41	0.79
	0.22				
Basitarsus		0.61	0.36	0.40	0.50
Total	2.67	3.09	3.45	3.09	4.29



Figs 9-16: *Schizomus buxtoni* Gravely ♀,
9. Cephalothorax, dorsal aspect; 10. Palp, dorsal aspect; 11. Femur IV, lateral aspect; 12. Tarsus, metatarsus I, dorsal aspect; 13. Sternite IV, ventral aspect; 14. Segments X-XII with flagellum, lateral aspect; 15. Spermathecae, dorsal aspect; 16. Spermathecae (magnified), dorsal aspect.

TABLE 2
MEASUREMENTS (IN MM): MALE SYNTYPE *S. BUXTONI* GRAVELY

	Pedipalp	Legs I	II	III	IV
Coxa	0.54	0.72	0.54	0.36	0.33
Trochanter	0.49	0.42	0.23	0.27	0.43
Femur	0.60	1.62	0.94	0.88	1.40
Patella	0.61	2.20	0.56	0.36	0.54
Tibia	0.54	1.55	0.65	0.4	1.10
Tarsus			0.56	0.52	1.00
	0.27	1.90			
Basitarsus			0.43	0.36	0.45
Total	3.05	8.41	3.91	3.15	5.25

Distribution: North Central and Central Provinces of Sri Lanka only.

ACKNOWLEDGEMENTS

I thank Dr J.R.B. Alfred, Director, Zoological Survey of India, Kolkata for the facilities to study the syntypes at ZSI, Kolkata. I thank Drs R.C. Basu, A.K. Sanyal, and B. Biswas for their kind co-operation during the studies, the Officers-in-Charge of ZSI, Arunachal Pradesh Field Station, Itanagar, and ZSI, Western Regional Station, Pune for facilities and the Artist section, ZSI, WRS, Pune for preparing the ink-lined illustrations.

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31. MORPHOLOGY OF *EURYCERCUS LAMELLATUS* (MULLER), CHYDORIDAE: CLADOCERA, FROM THE HIGH ALTITUDE WETLANDS OF SIKKIM, INDIA

(*With thirteen text-figures*)

Chydoridae is the largest family of the Order Cladocera, and is clearly defined morphologically and ecologically. Frey (1967) examined the phylogenetic relationships amongst its members and established four subfamilies, namely Eurycercinae, Sayciinae,

Chydorinae and Aloninae, of which Sayciinae is not represented in the Indian subcontinent. The remaining three subfamilies, with more than 50 species, are represented in India. The subfamily Eurycercinae is represented by *Eurycercus lamellatus* reported from Manasbal lake, Kashmir (Michael and Sharma 1988).

Further, by examining the major characters of the genus *Eurycercus* from various parts of the world, Frey (1975) established three subgenera, namely *Eurycercus*, *Teretifrons* and *Bullatifrons* for the *lamellatus*, *glacialis* and *macracanthus* groups.

The present study reports the occurrence of *Eurycercus lamellatus* (Muller 1776) from three high altitude wetlands of west and east Sikkim. A brief description of its external morphology and thoracic limbs is given below.

Eurycercus lamellatus (Muller 1776)

Material Examined: 13 adult females and seven neonates from Changu lake (east Sikkim, 23.v.1995), Sum Dung lake (East Sikkim, 29.xi.1995) and Tik Juk lake (west Sikkim, 19.xi.1995) coll. Bhupendra Nath Roy, Tadong, East Sikkim.

Female: Body Size: 2.21 ±0.26 mm (n=9). Body width: 1.675 ±0.24 mm (n=9). Shape oval. Dorsal margin of carapace convex, ventral margin straight. Posterodorsal and posteroventral corners of carapace rounded (Fig. 1). Dorsal keel present, head keel absent. Labrum convex, triangular, with a blunt curve at the distal end (Fig. 2). Antennules with sharp incision; sensory seta situated in the middle of anterior margin (Fig. 3). Antennal seta 0-0-3/1-1-3. Eye larger than ocellus, ocellus small, situated at the base of the antennule. Midgut with single loop; caecum short. Carapace with row of setae on ventral margin and a row of small spinules at the end of ventral margin and posterior margin (Fig. 4).

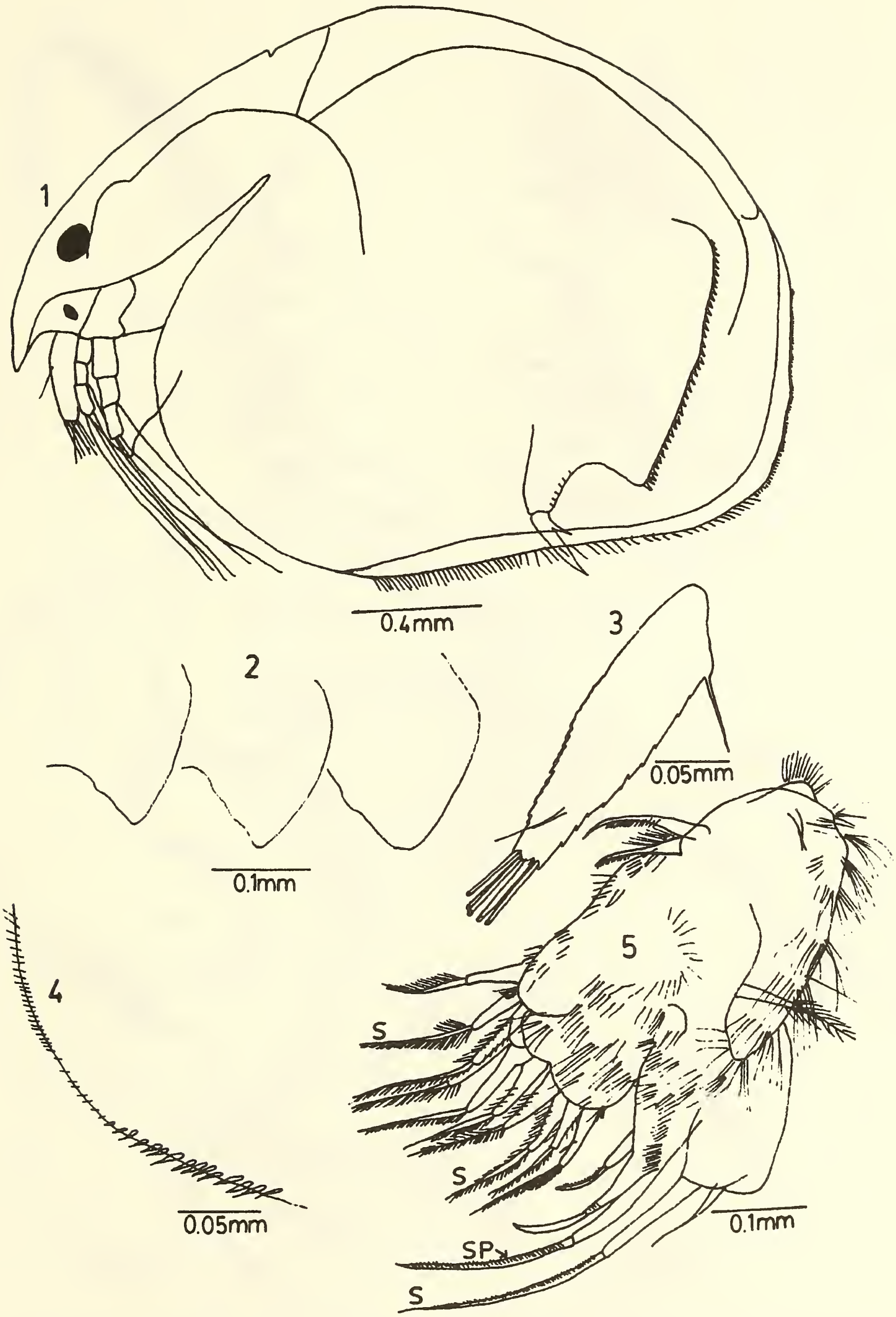
Thoracic limb I: Bears 3 setae in the inner distal lobe (clasping hook) and 2 setae in the outer distal lobe. The middle seta of the inner distal lobe is immovable, with a heavily chitinized hook. The inner distal lobe also bears proximal, marginal and distal spinules, and a group of grinding tubercles (Fig. 5).

Thoracic limb II: Size of scraping spine 2 and 3, 1 and 4, almost the same. Number of scraping setules 9-12 (Fig. 6).

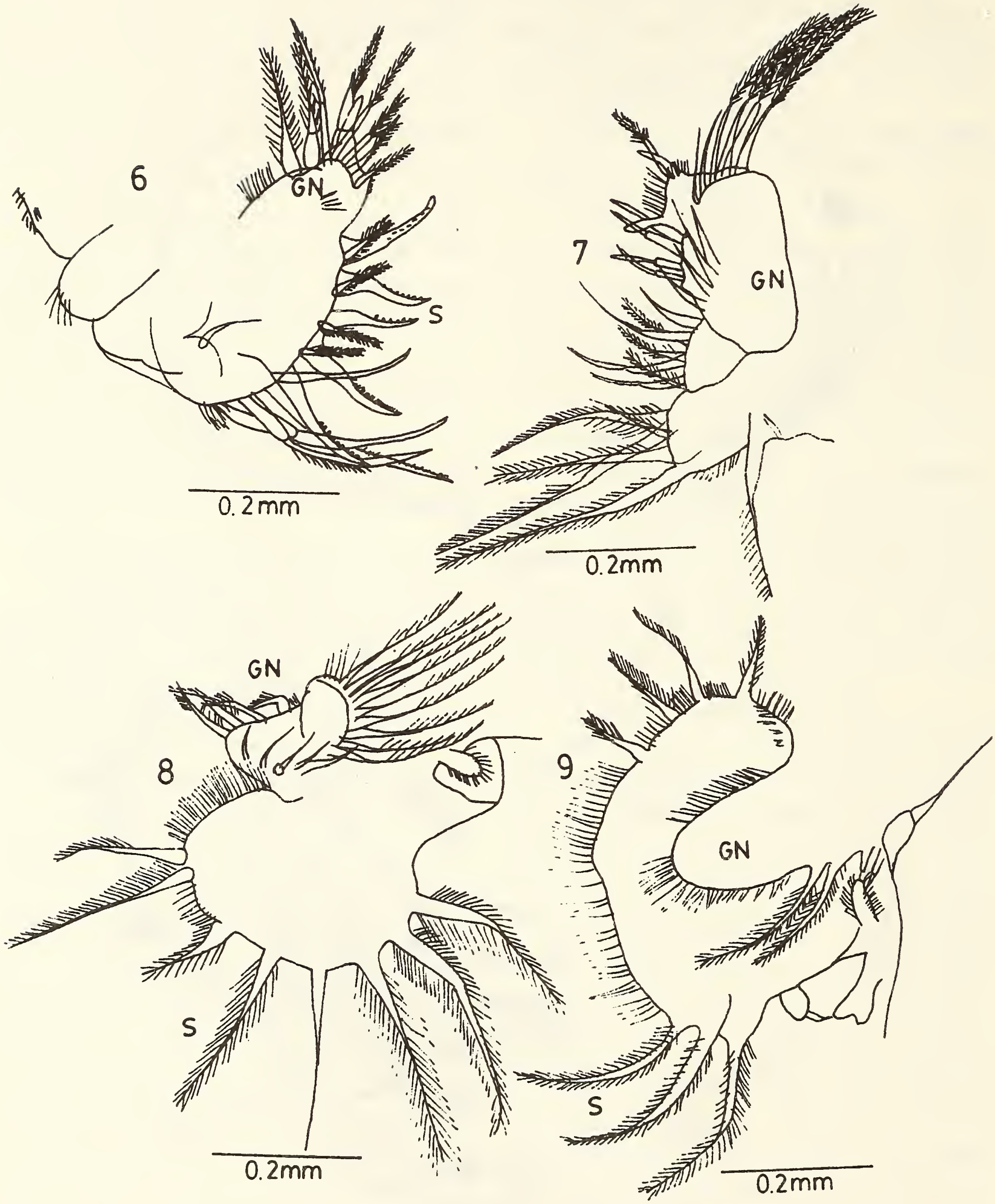
Thoracic limb III, IV, V & VI (Figs 7-10): Thoracic limb III with 6 setae in the gnathobase, with 7 setae on the outer surface of the endite (Fig. 7). The middle one of the 3 feathered setae on the gnathobase near the sensilla is slightly shorter than the other 2 in the thoracic limb V. Limb IV with 8 soft and 9 gnathobasic setae, and limb V with 7 soft setae. Limb VI as in Fig. 10.

Postabdomen (Fig. 11): Concave abruptly beyond the distalmost tooth. Distal preanal spine much larger than others, gradual decrease in size towards proximal end. Claws with 2 basal spines, distal spine longer. Concave margin with setae. Head shield (Figs 12-13) length and width not equal. Median pore larger, oval, with a small lateral pore on either side (Fig. 13).

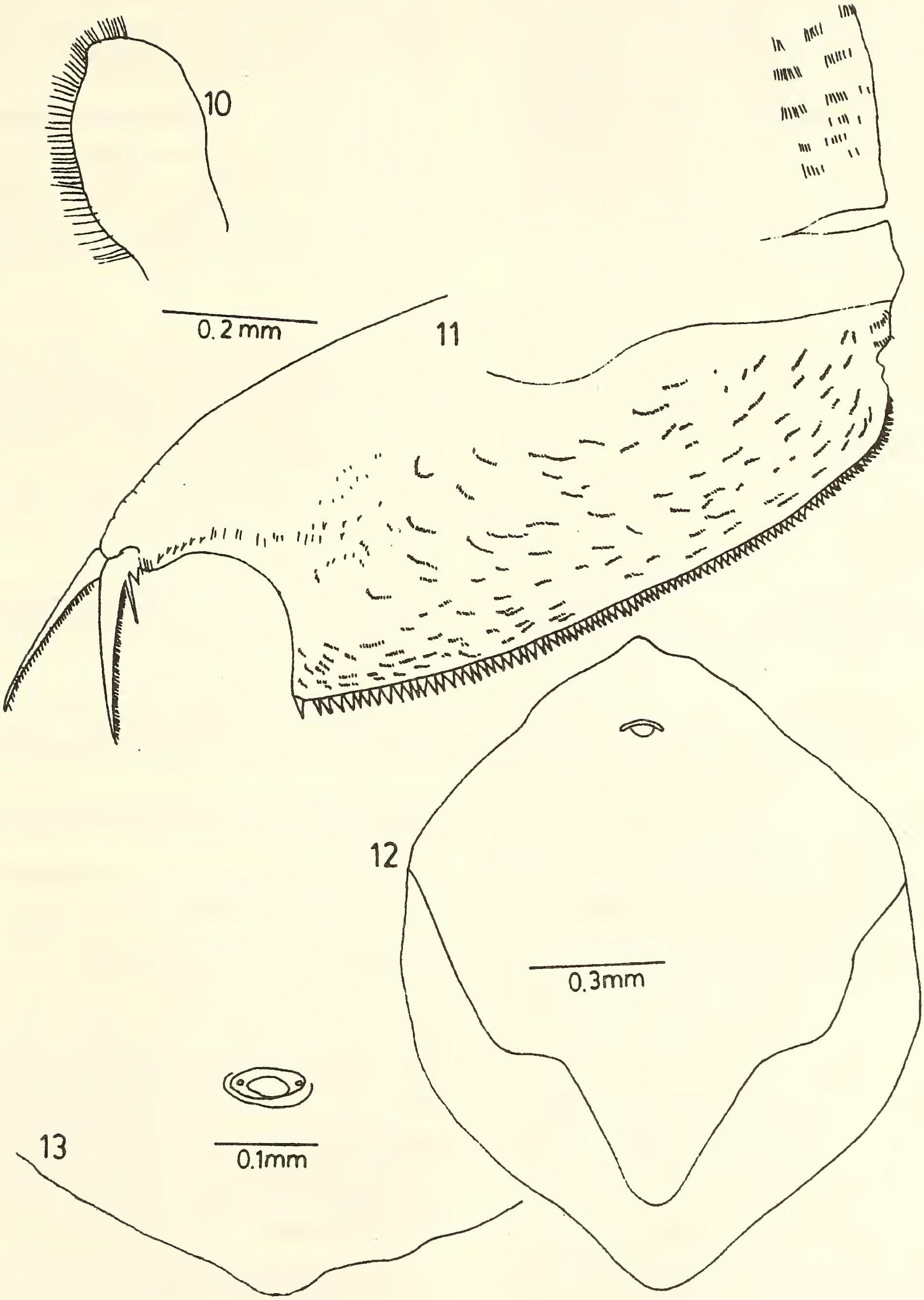
Remarks: In India, *E. lamellatus* was recorded from Manasbal lake, Kashmir (only 2 specimens from littoral zone, badly preserved and distorted) by Michael and Sharma (1988). A head shield of *Eurycercus* has been reported from Jabalpur, Madhya Pradesh (central India), supposedly carried there by a river originating in the Himalaya (Adholia 1979, Fernando and Kanduru 1984). Sharma and Michael (1987) indicated that *E. lamellatus* is restricted to Kashmir (above 32° N); they also collected a specimen of *Eurycercus* from lower altitudes in the Jaintia hills, northeast India, from an abandoned paddy field. Dumont and Van de Velde (1977) collected a number of specimens of *Eurycercus* sp. in Tsho III loc. 1, which were sent to the late Dr. D.G. Frey for further study, who said that they represented an undescribed species.



Figs 1-5: *Eurycercus lamellatus*, Female, 1. lateral view; 2. labrum; 3. antennule; 4. posteroventral corner; 5. thoracic limb (S-setule; SP-spinule).



Figs 6-9: *Eurycercus lamellatus*, Female, 6. II thoracic limb; 7. III thoracic limb; 8. IV thoracic limb; 9. V thoracic limb (S - setule; GN – gnathobase).



Figs 10-13: *Eurycercus lamellatus*, Female, 10. VI thoracic limb; 11. postabdomen; 12. head shield; 13. head pore.

The present study on material collected from the eastern Himalayan region clearly shows no difference in trunk limb morphology of females. Unfortunately, no males were found. Since male morphology is considered decisive for the taxonomy of most Cladocera (Venkataraman 1995), efforts should be made to study the males of the present species from remote areas in the Himalaya.

I thank the Director, Zoological Survey of India, for facilities; Mr. B.N. Roy and Dr. Tappa, Sikkim Govt College for collections.

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32. NEW RECORD OF THE MUD SNAIL, *HYDROBIA* (MOLLUSCA : GASTROPODA) FROM THE MANGROVE HABITAT OF INDOPACIFIC REGION

During an intensive survey of the macrobenthos of Cochin mangroves in Kerala by Sunil Kumar (1993), *Hydrobia* sp. was collected from the intertidal soil habitat. In the entire two-year period of study, large numbers of mud snails (Hydrobiidae) were found in the mangrove subsoil. Survey of the literature revealed that this occurrence of the mud snail, *Hydrobia*, is the first record from the Indian mangrove environment and from the mangrove systems of the Indo-Pacific region, including South Africa, Malaysia, Thailand, Australia, Japan and Hawaii.

The ecology and distribution of mud snails (Hydrobiidae) was worked on by Nicol (1936), Spooner and Moore (1940), Newell (1962, 1965), Fenchel (1975a, b), Wells (1978), Barnes (1979), and Walters and Wharfe (1980). However, the species has not been reported from the mangrove ecosystem.

In India, Pillai and Appukuttan (1980), while studying the molluscs in and around the coral reefs of the southeastern coast of India, compared the mangrove-associated molluscs of that area in Manauli Island with those of the mangrove forms of the East Indies (Cooman, 1969) and Western Indian Ocean (Taylor 1968). They stated that Indian mangroves have faunal elements from both eastern and western parts of the Indian Ocean. However, in their work there was no report on the distribution of the infaunal mollusc, *Hydrobia*.

A comparison of the mangrove molluscan fauna of south India with that of Malaysia (Berry 1963) and South Africa (Macnae 1963, Brown 1971) has been done by Kasinathan and

Shanmugam (1985), who opined that south Indian and Malayan mangroves have a greater affinity for molluscan fauna than the mangroves of South Africa and south India. However, *Hydrobia* was not reported in the study.

Faunal surveys, including the molluscan fauna, have been carried out in different mangrove ecosystems of the Indo-Pacific region (Walsh 1967, Macnae 1967, 1968, Sasekumar 1974, Frith *et al.* 1976, Wells 1983, Shokita *et al.* 1989, Omori 1989) including India (Sunil Kumar 2000). None of these epifaunal and infaunal studies on intertidal mangrove areas reported the occurrence of *Hydrobia* sp., except Sunil Kumar (1993), from Cochin. Hence, from the literature stated above, it is to be noted that *Hydrobia* was earlier reported from areas other than mangrove habitats. The occurrence of *Hydrobia* sp. in the Cochin mangrove soil is, therefore, the first record from Indian mangroves and from other mangrove environments of the Indo-Pacific region.

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33. MANGROVE CLAM *GELOINA EROSA* (SOLANDER, 1786) FROM CORINGA (GODAVARI) ESTUARY: A NEW RECORD FOR ANDHRA PRADESH

During a faunistic survey of Coringa (Godavari) estuary (*c.* 16° 30'-17° 00' N and 82° 14'-82° 23' E) in August 1999, 3 molluscan shells were collected which were identified as *Geloina erosa* (Solander 1786). The mangroves *Avicennia marina*, *Exoecaria agallocha* and *Sonneratia apetala* dominate the habitat from which the shells were collected. The anterio-posterior axis of the shell (bearing a distinct flexure extending from the umbo to the mid-posterior margin) ranged between 52 and 68 mm.

This species was reported as common along the mangroves of the Indian Ocean, extending its range further east into the Pacific Ocean (Prashad 1932). The information about its distribution in Indian waters is limited. Specimens were collected in the past from False Point, Andaman and Nicobar Islands, Mahanadi river (Mitra *pers. comm.*) and the Mandovi estuary (Ingole *et al.* 1994). The species has not been recorded from Coringa (Godavari) estuary and thus, constitutes a new record.

I thank Mr S.C. Mitra of the Mollusca Division, Zoological Survey of India, Kolkata for information on the distribution of the species and the Head, Department of Zoology, Osmania University for facilities. I acknowledge a Senior Research Fellowship from CSIR, New Delhi.

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34. TWO NEW PLANT RECORDS FOR INDIA FROM SIKKIM

(*With two text-figures*)

Botanical explorations undertaken in the state of Sikkim since 1980 have resulted in a collection of more than 19,000 field numbers in the Herbarium of Sikkim Himalayan Circle, Botanical Survey of India, Gangtok. Study of some of these collections, resulted in identifying

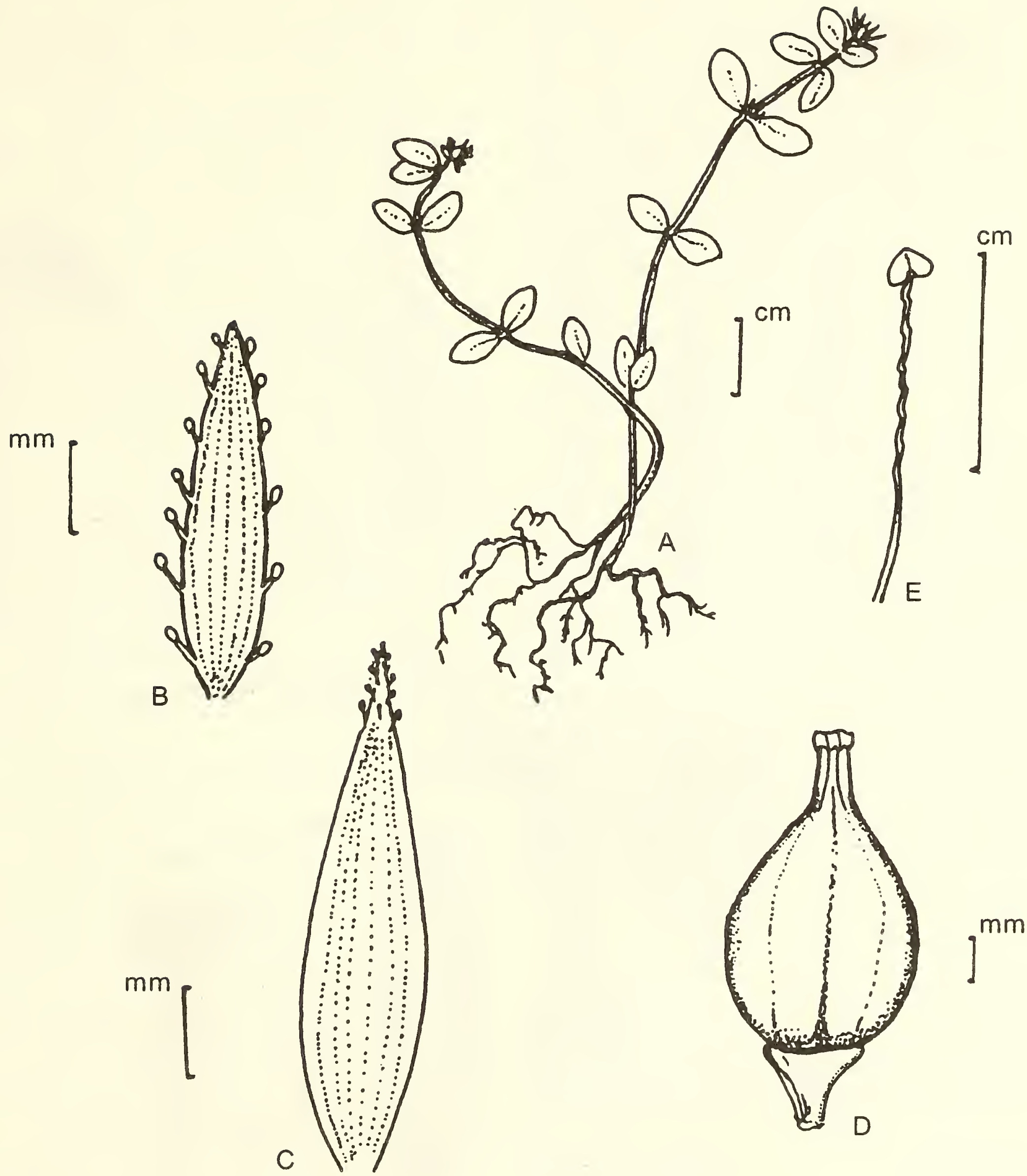

Fig. 1: *Hypericum ludlowii* N.B.K. Robson, A. Habit; B. Sepal; C. Petal; D. Gynaecium; E. Stamen

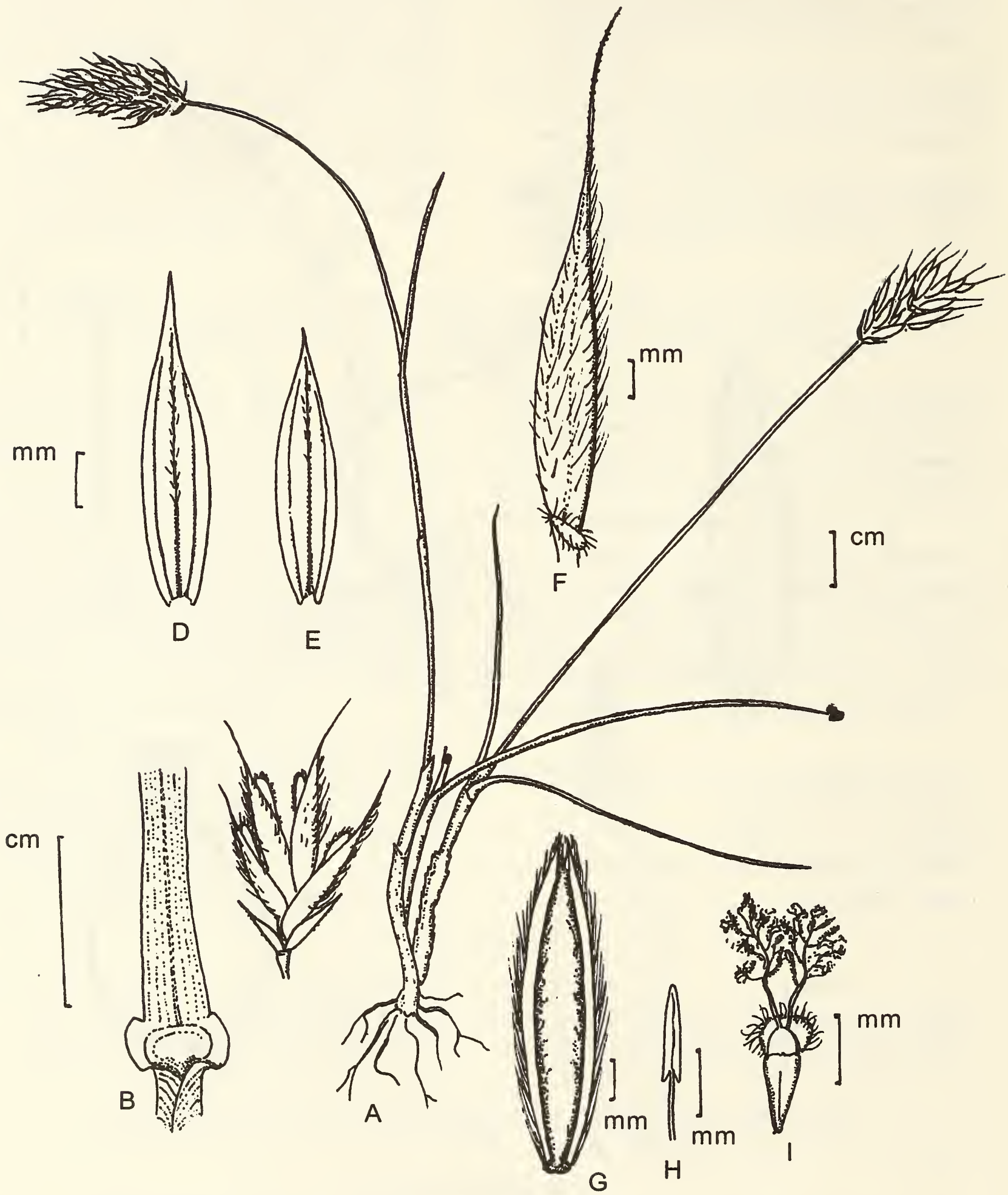

Fig. 2: *Elymus thoroldianum* (Oliver) G. Singh, A. Habit; B. Auricles; C. Spikelet; D. Lower glume; E. Upper glume; F. Lemma - lateral view; G. Palea; H. Stamen; I. Gynaecium

two plants not known earlier from India. The two species are reported, described and illustrated here. The herbarium specimens are deposited in the Herbarium, Sikkim Himalayan Circle, BSI, Gangtok, (BSHC).

1. ***Hypericum ludlowii*** N.B.K. Robson in Notes Roy. Bot. Gard. Edinburgh 41(1). 133. 1983. (Hypericaceae). Fig: 1.

Suberect herbs up to 10 cm high; stems terete, unbranched. Leaves opposite, up to 1 x 0.5 cm, oblong-ovate, rounded at base, entire at margins, obtuse at apex, glabrous above, puberulous and gland-dotted beneath. Flowers solitary, terminal, up to 7 mm across, bisexual, yellow, pedicels *c.* 2 mm long, glabrous. Sepals 5, *c.* 4x1 mm, linear-lanceolate, glandular-ciliate, acuminate at apex. Petals 5, *c.* 6x1.5 mm, lanceolate, entire at margins, acuminate at apex, glandular hairy near apex. Stamens 12, *c.* 6 mm long, anthers dorsifixed. Ovary ovoid, *c.* 4 mm across, styles 3-4, connate, *c.* 2 mm long stigma capitate. Capsules not seen.

Specimens examined: North Sikkim: Yumthang, 26.vii.1989, *N.R.Mandal* 10085 (BSHC).

Distribution: INDIA: Sikkim (New report), Bhutan, China (Tibet).

Notes: This species is closely related to *H. petiolulatum* Dyer, but is different in being (i) a sparsely branched herb (ii) leaves elliptic, subsessile (iii) flowers solitary and (iv) sepals glandular ciliate, whereas the latter is (i) a much branched herb with (ii) ovate leaves, shortly petiolate, petiole up to 4 mm long, (iii) flowers 1-3 and (iv) sepals entire at margin or with a few sessile glands, but never glandular ciliate.

2. ***Elymus thoroldianum*** (Oliver) G. Singh in Taxon 32 (4): 640. 1983. *Agropyron thoroldianum* Oliver in Hook, Ic. Pl. t. 2262. 1893; Bor, Grasses Ind. 667. 1960. (Poaceae). Fig:2.

Tufted perennials up to 20 cm high, culms glabrous. Leaf sheaths glabrous on margins; leaf blades up to 8 cm long, herbaceous. Spikes up to 4 x 1.5 cm, golden yellow, dense; axis tough, continuous. Spikelets solitary at each node of the spike axis, 3-4 flowered, breaking at maturity. Glumes lanceolate; lower glume *c.* 5.5 x 1.5 mm, upper glume *c.* 5 x 1.5 mm, upper glume *c.* 5 x 1.5 mm, gradually tapering into a short awn at apex, coriaceous, 3-nerved, midrib pubescent. Lemma *c.* 8 x 3 mm, elliptic-lanceolate, 3-nerved, silky villous with scattered long hairs on the midrib; awn 4-5 mm long, scabrid. Palea *c.* 7 x 2 mm, elliptic, long ciliate on the keels. Stamens 3, *c.* 2.5 mm long, anthers *c.* 1.5 mm long. Ovary obovoid, *c.* 1.5 mm long, with a silky hairy appendage at apex; styles 2, stigma fimbriate.

Specimens examined: North Sikkim: Near Gurudongmar lake, 5,300 m above msl, 5.x.1997, *P.Singh & S.S.Dash* 20050 (BSHC).

Distribution : INDIA: Sikkim (new report), China (Tibet).

Notes: A rare grass, collected only from one site near the Indo-Tibetan border in Indian territory. It differs from other Indian species of *Elymus* in having spikelets solitary at each node, lemmas silky villous and anthers *c.* 1.5 mm long. This species was originally described under *Agropyron* from Tibet, but with the re-evaluation of generic limits in the tribe Triticeae, it is now placed under *Elymus*.

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35. YIELD RESPONSE OF *CALOPHYLLUM INOPHYLLUM* ON INTRODUCTION OF RED ANTS *OECOPHYLLA SMARAGDINA*

Calophyllum inophyllum Linn. is a broad leaved evergreen tree being cultivated for its oil yielding fruit. The oil extracted from the fruit has been used as fuel for rural chimney lamps. *C. inophyllum* bears flowers during April-May and August-September and the large clusters of fruit attain maturity 3-4 months after flowering. About 26-42% of the fruit between 1-2.4 cm in diameter are destroyed by the five striped palm squirrel *Funambulus pennanti* (Seshagiri Rao 1972). The squirrels make holes in the soft seed coat and consume the developing embryo. No biological method is known so far, that can prevent damage to the young fruit by squirrels.

The red weaver ant *Oecophylla smaragdina* Fb., prefers *Calophyllum inophyllum* as one of its host plants (Kumaresan 1998). Its pest control activity has been known for many years. It destroys borer grubs of beetles on date palm (Debach 1974), *Levuana iridescens* on coconut (Tothill *et al.* 1930), citrus shield bugs (Hill 1983) and rhinoceros beetles on coconut (Kumaresan 1996). Keeping this in mind, red ants were introduced on *Calophyllum inophyllum* to check the damage to fruit by squirrels.

Fifty *Calophyllum inophyllum* trees were selected and red ants were introduced on 25 trees. Twenty-five inflorescences were selected from each tree and tagged with numbers at the time of flowering. The number of flowers per inflorescence, number of young fruit in the cluster, number of young fruit damaged by squirrels were studied at flowering time, and the number of mature fruit in a cluster was recorded at harvest time for 3 years between April 1995 and December 1998 (Table 1).

TABLE 1
YIELD RESPONSE OF *CALOPHYLLUM INOPHYLLUM* AFTER RED ANT INTRODUCTION

Treatment	Average No. of Flowers	No. of young fruits	No. of fruits damaged	No. of mature fruits
Antless tree	12	8	3	5
Tree harbouring red ants	12	10	<1	9.4

The higher number of young fruit in trees harbouring ants may be due to the assistance of red ants in pollination. Fruit damaged by squirrels was less than one per cluster, and remained in the cluster for 3-5 days after the damage was caused.

The red ants bit invading squirrels and injected formic acid at the site of the bite. This annoying behaviour of the red ants kept squirrels away from the trees, thus reducing the fruit damage. The daily visits of squirrels ranged from 62 to 83 in ant-free and 26-42 in ant harbouring trees. The odour of the ants might also be responsible for decreased visits to the trees.

Red ants act as pollinators for *Calophyllum inophyllum* and increase fruit set at the flowering stage. In the later stages, they keep the squirrels away from the trees and help to decrease the damage to immature fruit. The red ants can therefore be used to get a good yield from *Callophyllum inophyllum*.

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36. ON THE DISTRIBUTION RANGE OF *BAUHINIA GLAUCA GLAUCA* (BENTH.) BENTH. (LEGUMINOSAE: CAESALPINIOIDEAE) IN INDIA

Bentham (1861: 99) mentioned that *Bauhinia glauca* (Benth.) Benth. extends from "Khasia and Burma to Sumatra and Java". The range of distribution was given on the basis of collections in the Hookerian and other herbaria in Kew, and notes and observations of J.D. Hooker on living flora of Sikkim and Khasia (see Bentham 1861, Preface: 11*-13*). Baker (1878: 283), however, did not include Khasia in the distribution of *B. glauca*, although it is quite probable that he too had examined all the collections studied by Bentham in Kew, and had personal knowledge of J.D. Hooker's notes and observations on the living flora of Sikkim and Khasia.

On the other hand, de Wit (1956: 490) and Larsen and Larsen (1973: 10; 1980: 184) again included Khasia, like Bentham, in the world distribution of the taxon. But in subsequent regional floristic studies, it was not recorded from Khasia, now in Meghalaya (Kanjilal *et al.* 1938; Haridasan and Rao 1985). Sanjappa (1992: 3) mentioned that *B. glauca* ssp. *glauca* is found in Meghalaya and Mizoram.

Dr. Sanjappa kindly informed me (1998 *pers. comm.*) that he had given the Indian distribution on the basis of Bentham (1861) and Fischer (1938). After going through the latter, I found that he had enlisted *B. glauca* on the basis of Gage (1901) on the flora of South Lushai hills, now in Mizoram. Gage (1901: 342) reported, without a field number, his own fruiting collection of *Bauhinia glauca* Wall. from Helio hill, Lungleh, at 3,700 ft (1,128 m). Further, he gave the distribution as 'Burma; Malaya; China' and stated that his collection was a decided northward extension for this species. From Holmgren *et al.* (1990: 172, 526), I found that A.T. Gage's collections are in CAL, but despite a thorough search there, I could not locate any fruiting collection of *B. glauca* from South Lushai hills by Gage without a field number. However, a fruiting collection with a duplicate (Helio hill, N.E. of Lungleh, South Lushai hills, 3,700 ft (1,128 m), 3.iv.1899, *Gage* 100 – CAL) identified as *Bauhinia glauca* Wall. was actually found to be *B. glauca* ssp. *tenuiflora* (C.B. Clarke) K. & S. S. Larsen. In fact, all the relevant specimens (*Clarke* 42304 D, 42342 B, *Craib* 177, *Deb* 2439, *Gage s.n.*, 100, *Leslie* 113, *Meebold* 6340, *Mokim* 35, 57, 259, *Rao* 8042, *Watt* 6915, *Wenger* 6 – all CAL; *Kanjilal* 5644 – DD) or their photographs (*Clarke* 42304 E, 42342 A & C, *Watt* 6915 – all K, photo. – CAL) examined so far by me from Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram and Nagaland in northeast India, have been found to be spp. *tenuiflora*, except for the collection *Rao* 8042 – CAL, which comes close to the Chinese taxon *B. glauca* ssp. *hupehana* (Craib) T. Chen (K. & S.S. Larsen *pers. comm.* 1997).

Recently, Larsen and Larsen (1996: 478) stated that ssp. *glauca* is distributed in south India, Burma, Malay Peninsula, Sumatra and Java, but there is neither any collection nor any report of ssp. *glauca* from south India.

The label on the collection *Helfer* 1864 – CAL of ssp. *glauca* showing the locality as

'Tenasserim and Andamans' is ambiguous, because after the murder of Dr. Helfer by the aborigines in the North Andaman Is., his collections from Tenasserim and Andamans were unfortunately mixed up. Afterwards, all of them were labeled together as 'Tenasserim and Andamans'. Thus, many of his Tenasserim plants have also been ascribed to the Andaman flora (Parkinson 1923, Introduction: xi). This particular specimen seems to me to be from Tenasserim, Myanmar (Burma) because no specimen of ssp. *glauca* has been collected from the Andamans since Helfer's collection, more than a hundred years ago.

This circumstantial evidence shows that the inclusion of India in the distribution range of ssp. *glauca* is not based on firm ground. The true picture is likely to emerge only after the completion of floristic surveys in the underexplored regions of northeast India and the Andaman and Nicobar Is.

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37. ON TWO SPECIES OF *OSBECKIA* LINN. (MELASTOMATACEAE)

In the course of taxonomic revision of Family Melastomataceae for the Flora of India Project, two new species, namely *Osbeckia darjeelingensis* Giri & Nayar and *O. nayarii* Giri were described, based on some old material deposited in the Central National Herbarium (CAL) and the herbarium of the Eastern Circle, Botanical Survey of India (ASSAM). Additional

collections of these species were made after a lapse of over 50 years from the adjacent areas. In this paper, the field status of both the species is discussed and descriptive notes are provided for identification.

Osbeckia darjeelingensis Giri & Nayar *In*: Bull. Bot. Surv. India 25(1-4): 241-243, Fig. 1. a-f (1983) 1985.

Branched shrubs, stem and branches hexangular, densely covered with short, rigid, appressed hairs. Leaves linear-lanceolate, 3-5 nerved. Inflorescence a condensed panicle, bracts broadly ovate, often appear in series. Calyx tubes (hypanthium) sparsely covered with gland tipped emergences, intersepalar emergences with a terete stalk, hairy along length and terminated by a strong bristle. Petals obovate, bright purple. Capsules enclosed by urceolate calyx-tubes.

Note: The description of *O. darjeelingensis* was based on herbarium specimens collected during 1868-1910. The present collection was made during a survey of the phanerogamic flora of Jaldapara Wildlife Sanctuary, Jalpaiguri district in December, along with flowers and fruits (*Chandra and Mandal* 1105). The species was collected along with two other Melastomataceae species, namely *O. malabathricum* L. and *O. nepalensis* Hook. f. *O. malabathricum* is widely distributed throughout India, except in the arid zone, and *O. nepalensis* in the Eastern Himalayan ranges, extending to the northeastern states.

The present collection of *O. darjeelingensis* was made from a single undisturbed spot at a lower altitude than the previous records. Presently, the status of the species is indeterminate (presumed rare) and thorough search in range localities and effective measures for protection in the wild are needed. However, as the flowers and leaves of the species are very showy, it can well be introduced into gardens to serve the dual purposes of ornamentation and *ex situ* conservation.

Specimens examined at CAL: West Bengal: Darjeeling Terai, 29.x.1876 *Gamble* 20513; Darjeeling Terai, *Gamble* 28021; N. Bengal, Silligoree, 27.x.1868, *Kurz s.n.*; Buxa Red., W. Duars, Jan., 1880, *Gamble* 7671; NEC Beat of Jaldapara Wildlife Sanctuary, Jalpaiguri dist., 9.xii.1995, *S. Chandra & S.K. Mandal* 1105.

Sikkim: Sikkim Terai, *Ribu s.n.* (CAL); Mahanadi, Terai, 200-400 ft (61-122 m), 13.xii.1910, *Ribu & Rhomoo s.n.*; Sikkim, *J.D.H. s.n.*; locality not mentioned, *Narayanaswami s.n.*

Osbeckia nayarii Giri *In*: J. Econ. Tax. Bot. 4(2): 609. Fig. 1. A-E. 1983.

Branched herbs, stem and branches strongly quadrangular and distinctly winged at angles, glabrous. Leaves ovate-elliptic to ovate-lanceolate, 5-nerved. Inflorescence axillary or terminal condensed panicle; bracts ovate, calyx tubes (hypanthium) urceolate, glabrous; intersepalar emergences rudimentary, as a simple hair. Petals ovate-oblong, pinkish-purple. Capsules enclosed by urceolate, glabrous calyx-tubes with a distinct long neck.

Note: *O. nayarii* was described on the basis of specimens collected in 1886-1938 mainly from Khasia hills of Meghalaya and surroundings. The collection from Bengal Orientale [Bengal Or.] (*J.D.H. & T.T.*) is probably from the northeastern part of West Bengal, adjacent to the Assam border. The last collection of the species cited below was made from Shillong at *c.* 1,200 m, in 1986 during field study (*Pal s.n.*). A recent personal communication from the Scientists in the BSI, Eastern Circle, Assam also says that a good population exists in the area of the last collection. In the present study, additional material collected by Dr. King's collector in 1886, No. 239 (Acc. No. 171989) from Chittagong Hill Tracts,

Bangladesh was also traced at CAL and identified as *O. nayarii* Giri, which extended its eastern distribution.

Specimens examined at CAL: INDIA: Assam: Pantung Forest, 5.iv.1938, *K. Biswas s.n.*; locality not mentioned, *Junkings s.n.* Meghalaya: Khasia, *ca* 600 m, 14.ix.1886, Clarke 44776 A (Holotype); *Ibid., Clarke* 44776 B-D (Isotypes); Khasia, *G. Mann s.n.*; Shillong, *ca* 1,200 m, 7.v.1986, *Pal s.n.*; West Bengal: Bengal Or., *ca* 1,200 m, *J.D.H. & T.T. s.n.*

BANGLADESH: Chittagong Hill Tracts, 1886, Dr. King's collector No. 239.

ACKNOWLEDGEMENT

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38. FIRST RECORD OF GUM EXUDATION FROM THE GONDA TREE *CORDIA MYXA* LINN. (FAMILY: BORAGINACEAE)

Gonda *Cordia myxa* Linn. (Boraginaceae) is an important horticultural tree. Gonda is also reported to have medicinal and therapeutic value (Chopra *et al.* 1956). In this paper, we report for the first time gum exudation from Gonda tree. In December, 1994, 490 gm of the gum was collected from trees around Jodhpur. The gum was in the form of irregular broken tears of varying size, generally colourless, with a brittle, fractured surface. The sample was odourless, mucilaginous and tasted bland. The powder was white in colour. The gum was practically insoluble in alcohol and almost entirely soluble in twice its weight of water, yielding a highly viscous, slightly acidic solution. When diluted with more water and allowed to stand, the sample produced a negligible amount of gummy residue. It was distinguishable from the Indian gum described in THE PHARMACOPOEIA OF INDIA (Anon 1970): (i) it produced a greenish instead of blue colour on treatment with hydrogen peroxide and benzidine, and (ii) it gave a white precipitate with lead acetate instead of no precipitate. Despite slight variations in its properties compared to Indian gum, the high solubility in water and attractive physical appearance of the Gonda gum may be exploited for use in various applications.

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We thank Dr A.S. Faroda, Director, Central Arid Zone Research Institute, Jodhpur for his keen interest and encouragement.

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39. DISTRIBUTION OF *OBERONIA BRACHYPHYLLA* BLATT. & MCCANN — A RARE, ENDEMIC ORCHID OF WESTERN GHATS, INDIA

(*With two text-figures*)

Oberonia brachyphylla Blatt. & McCann is one of the rare orchids listed in the red data book of Indian plants (Nayar and Sastry 1988). This tiny little orchid was described by Blatter and McCann (1931) from a detailed illustration prepared by T.R. Bell & Miss Bell, made from live specimens collected in North Kanara (Santapau and Kapadia 1966). Later, Santapau and Kapadia (loc. cit.) also collected it from North Kanara and reported it to be apparently endemic to North Kanara. Subsequent workers have recorded this species from other parts of Western Ghats. Joseph and Vajravelu (1976) reported it from Palghat district, Kerala. In 1981, Abraham and Vatsala reported it from Ponmudi, Kerala, which seems to be the southernmost recorded distribution of this orchid. Ansari *et al.* (1982) reported its distribution from North Kanara and Kerala, based on Santapau and Kapadia (loc. cit.), and Joseph and Vajravelu (1oc. cit). But it is interesting to note that Vajravelu (1988), while discussing its distribution, has not taken North Kanara, Karnataka and Ponmudi, Kerala into account and mentioned only Hassan and Palghat districts. Ansari and Balakrishnan (1990) in their revision of *Oberonia* species mentioned only Maharashtra and Kerala as distribution centres. There is no mention of this species in FLORA OF MAHARASHTRA by Lakshminarasimhan (1996). During our floristic survey of endemic plants of Western Ghats, we collected this species from two more localities: 1. Molem-Anmode, Goa. 2. Agumbe, Shimoga district, Karnataka. While examining the specimens at MH, the specimens from Chikmagalur, Karnataka were also noticed. Thus, it was observed that the distribution of this species was relatively unknown.

Small size and the lack of frequent and intensive collections could be the reasons for very few collected specimens of this species, as a result of which its distribution appeared to be restricted and fragmented. Now it is apparent that the species is distributed more or less continuously along the Western Ghats (Fig. 1). The specimens collected by us have been deposited in the Herbarium of the Department of Botany, Goa University.

Oberonia brachyphylla Blatt. & McCann in J. Bombay nat. Hist. Soc. 35: 257, t.2.1931; Sant. & Kapad., Orch. Bombay 57. 1966; Sald. & Nicol., Fl. Hassan Dist. 838. 1976; Abraham and Vatsala, Int. Orch. 416, f. 116. 1981. Ansari

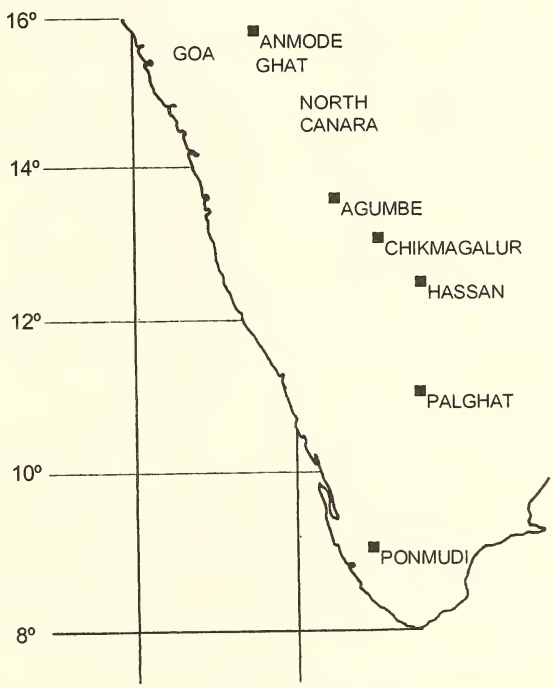

Fig. 1: Distribution of *Oberonia brachyphylla* Blatt. & McCann in Western Ghats

et al., J. Econ. Tax. Bot. 3: 114. 1982; Manilal, Fl. Silent Valley 296. 1988; Vajravelu, Fl. Palghat 486. 1990; Ansari & Balakrishnan, Orch. Monog. 38. 1990.

Fl. & Fr.: March-April.

Habitat: Epiphyte on *Garcinia* and *Ziziphus* spp.; on small twigs with moss, in open areas in evergreen forest patches.

Distribution: Western Ghats [Goa, Karnataka (N. Kanara, Shimoga, Chikmagalur, Hassan), Kerala (Palghat, Thiruvananthapuram district)]

Specimens examined: Molem-Anmode, Goa, Vaishali Joshi and S. Rajkumar 1528; Agumbe, Shimoga district, Karnataka, M.K. Janarthanam, Vaishali C. Joshi and S. Rajkumar, 14.iii.1998, *s.n.*; Yelaneer Ghat, Chikmagalur, Vajravelu, 25.ii.1984 (MH); Mandampatty, Palghat, N.C. Nair 12.iv.1978, 56781 (MH); Mukkali, Palghat, Vajravelu 26.vii.1977, 49781 (MH).

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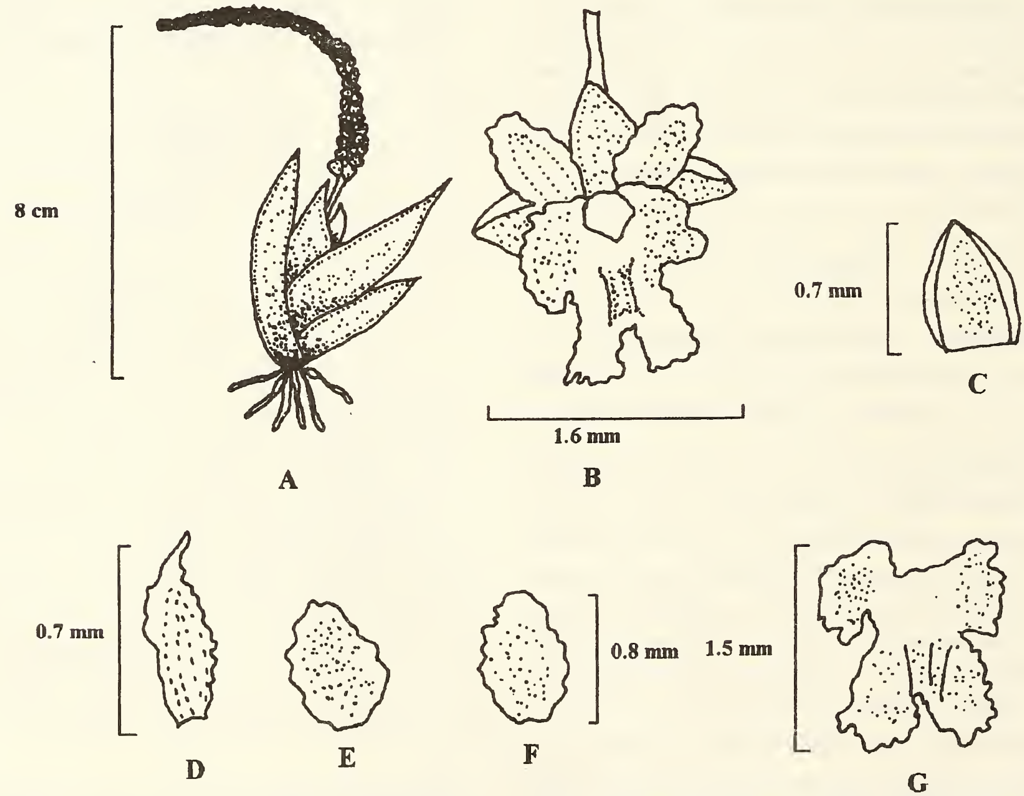

Fig. 2: *Oberonia brachyphylla* Blatt. & McCann A - habit; B - flower; C - dorsal sepal; D - lateral sepal; E & F - petals; G - lip

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40. NEW RECORDS OF THE FAMILY ERIOCAULACEAE FROM GOA

The species of the genus *Eriocaulon*, known as pipeworts, are commonly seen during the monsoon along wetlands and streams. These plants show very little variation in their vegetative characters, though floral variations which can be observed under the microscope are enough to segregate and identify the species. The first revision of this group in India was carried out by Fyson (1919-1921). This work is generally neglected as it was published in parts and the volumes are available in a few libraries only. This group was not represented by Dalgado (1898), published prior to Fyson (l.c.). Vartak (1966) reported only four species of *Eriocaulon*, all from outside the state of Goa, whereas Rao (1986) reported twelve species from Goa state. The latest revision by Ansari and Balakrishnan (1994) has clarity and is more authoritative. Cook (1996) provided keys based on floral characters, whereas Ansari and Balakrishnan (l.c.) relied more on seed characters. The specimens identified in the light of these recent works have added six new distributional records to the State of Goa.

The identification of the specimens was confirmed at Botanical Survey of India, Pune and MH, Coimbatore. The specimens have been deposited in the herbarium of Department of Botany, Goa University.

Eriocaulon fysonii Ansari & Balakr., Eriocaul. India 89. f. 28 1994; Cook, Aqua. Wetland Pl. India 195. 1996; Lakshminarsimhan in Sharma *et al.*, Fl. Maharashtra Monocot. 752. 1996. *Eriocaulon cuspidatum* Dalz. var. *bracteata* Fyson in J. Indian Bot. 2: 318. 1921.

Note: Involucral bracts distinctly exceeding the head; seed appendages swollen at tip; found in puddles on lateritic plateaux; endemic to Western India.

Exsiccata: Goa, Lolium, M.K. Janarthanam 6, 24.viii.1996, Goa, Lolium V.C. Joshi & S. Rajkumar, 950, 10.ix.1997.

Eriocaulon lanceolatum Miq. ex Koernick in Linnaea 27: 656. 1856; Hook. f. Fl. Brit. India 6: 577. 1893; Cooke, Fl. Bombay 3: 357. 1967 (reprinted); Kulkarni, Fl. Sindhudurg 474. 1988; Ansari & Balakr., Eriocaul. India 29. f. 6. 1994; Cook, Aqua. Wetland Pl. India 196. 1996. *Eriocaulon lanceolatum* var. *pilosum* Moldenke in Phytologia 3: 164. 1949; Almeida, Fl. Savantwadi 2: 63.1990; Lakshminarsimhan in Sharma *et al.*, Fl. Maharashtra Monocot. 257. 1996.

Note: Scape and involucral bracts pilose; found in open grassy areas; endemic to South West India.

Exsiccata: Goa, Gotmode, opp. Nestle, M.K. Janarthanam & S. Rajkumar 860. 9.viii.1997.

Eriocaulon palghatense Ansari & Balakr., Eriocaul. India 111. f. 37. 1994; Bhat, *Ind. J. Forestry 2(1)*: 103 -104. 1997.

Note: Minute black headed herb; found on open lateritic plateaux covered with grass; earlier known only from Kerala (Ansari & Balakrishnan

l.c.) and Udupi, South Kanara (Bhat l.c.).

Exsiccata: Goa, Verna, M. K. Janarthanam 36, 17.viii.1996

Eriocaulon parviflorum (Fyson) Ansari & Balakr., Eriocaul. India 53. f 16. 1994; Cook, Aqua. Wetland Pl. India 198. 1996; Lakshminarsimhan in Sharma *et al.* Fl. Maharashtra Monocot. 754. 1996. *Eriocaulon dianae* var. *parviflora* Fyson in J. Indian Bot. 2: 260. 1921.

Note: Herb without rootstock and with boat shaped female sepals; found near streams in moist deciduous forests and puddles on lateritic plateaux; endemic to Central and Western India.

Exsiccata: Goa, Cotigao, V.C. Joshi & S. Rajkumar 487, 10.i.1997.

Eriocaulon quinquangulare L. Sp. Pl. 87. 1753; Hook. f. Fl. Brit India 6: 582. 1893; Cooke, Fl. Pres. Bombay 3: 361. 1967 (reprint); Kulkarni, Fl. Sindhudurg 475. 1988; Almeida, Fl. Savantwadi 2: 65. 1990; Ansari & Balakr., Eriocaul. India 104. f 34. 1994; Cook, Aqua. Wetland Pl. India 199. 1996; Lakshminarsimhan in Sharma *et al.* Fl. Maharashtra Monocot. 262. 1996.

Note: Vegetative parts often flushed with red, purple or pink; found in flooded paddy fields; distributed in Sri Lanka, Bangladesh, Myanmar and throughout India.

Exsiccata: Goa, Chandranath, M.K. Janarthanam 1474, 29.iii.1998.

Eriocaulon reductum Runland in Engl. Pflanzenr. 13: 113. 1913; Ansari & Balakr., Eriocaul. India 181. F. 65. 1994.

Cook (l.c.) treated *E. reductum* Runland conspecific with *E. cinereum* R. Br. But after observing a large number of specimens, we could distinguish *E. reductum* from *E. cinereum*. The former has sepals reduced to branched hairs, whereas the latter has linear subulate sepals. Hence, following Ansari & Balakrishnan (l.c.) *E. reductum* is dealt here as a distinct species.

Note: Puddles on lateritic plateaux; endemic to western part of peninsular India.

Exsiccata: Goa, Goa University Campus, V.C. Joshi & S. Rajkumar 958. 15.ix.1997.

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October 15, 1999

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41. NOTE ON *FIMBRISTYLIS MICROCARYA* F.V. MUELL. (CYPERACEAE), A NEW DISTRIBUTIONAL RECORD TO SOUTH INDIA

(*With one text-figure*)

During a floristic survey of the aquatic angiosperm diversity of Andhra Pradesh, some rare and interesting specimens of *Fimbristylis* Vahl were collected. The present report decribes a rare and interesting taxon, which is identified as *Fimbristylis microcarya* F.v. Muell. The species has not been recorded from south India. Hence, it is reported as a new record. The voucher specimens were prepared according to Santapau (1955), and Jain and Rao (1977) and deposited in SKU herbarium, Sri Krishnadevaraya University, Anantapur.

Remarks: Along the margins of lakes, streams, in waterholes and moist places.

Fl. & Fr.: August-October.

Distribution: WORLD: Australia, South and southeast Asia.

INDIA: Maharashtra, Sikkim, Uttar Pradesh and Andhra Pradesh.

Specimen studied: Gandhipet (Hyderabad), KI and NVN-18766; Nirmal (Adilabad), MHR and KI 14472.

Note: Cook (1996) reported 3 stamens in *Fimbristylis microcarya* F.v. Muell., while Koyama (1985) noticed 2-3 stamens in his specimens. However, a single stamen was observed in our specimens.

The species can be distinguished from the closely allied species *F. complanata* (Retz.) Link by the following characters:

F. complanata (Retz.) Link	*F. microcarya* F.v. Muell.
Culms 20-90 cm long.	Culms 10-39 cm long.
Spikelets 5-8 mm long, 2 mm wide.	Spikelets very small 2-4 mm long, 1 mm wide.
Glumes 2-3 mm long (excluding the cusp).	Glumes 1 mm long (excluding the cusp).
Style 1-1.2 mm long.	Style 0.5-0.75 mm long.
Nuts 0.7-1 mm long, 0.5-0.7 mm broad.	Nuts 0.5-0.6 mm long, 0.3-0.4 mm broad.
Nuts warty, rarely smooth.	Nuts with minute warts.

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see page 158 for text-figure

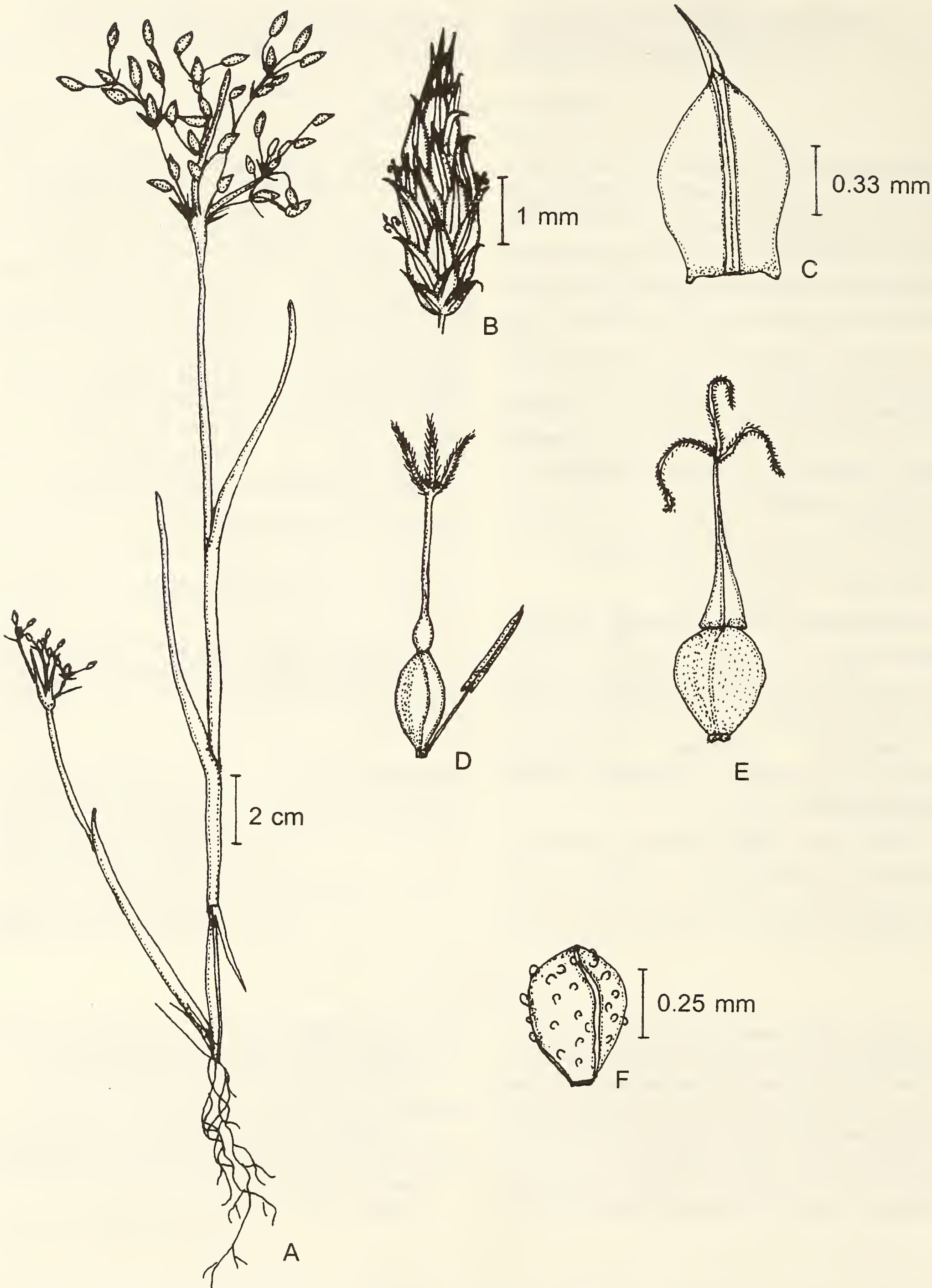

Fig. 1: *Fimbristylis microcarya* F.v. Muell.: A. habit; B. spikelet; C. glume; D. pistil with stamen; E. nut with style; F. nut.

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Cover: Bird paintings by Carl D'Silva © BNHS

THE HOURS—From the painting by Arthur Hacker

The Hours

The Hours meant to the Greeks not the divisions of the day, but those of the year. They were the goddesses of the seasons. They were responsible for the opening and closing of the doors of Olympus, for the education of children, and the general rules of human lives. It is why they always attend marriages, as we see in pictures. Modern painters represent them winged like butterflies, suggesting the flight of time, which would do as well for birds.

* * *

Time

Why sitt'st thou by that ruined hall,
Thou aged carle so stern and grey?
Dost thou its former pride recall,
Or ponder how it passed away?

"Know'st thou not me?" the Deep Voice cried;
"So long enjoyed, so oft misused—
Alternate, in thy fickle pride,
Desired, neglected, and accused!

"Before my breath, like blazing flax,
Man and his marvels pass away,
And changing empires wane and wax,
Are founded, flourish, and decay.

"Redeem mine hours—the space is brief—
While in my glass the sand grains shiver
And measureless thy joy or grief
When Time and thou shalt part for ever!"

Sir Walter Scott gives a fine sense of mystery and awe to the grim figure of old Father Time in this little poem. Time is always shown to us as an old man with an hour-glass and a scythe to suggest the passing of the hours and the reaping of Time's harvest. Carle is an old-fashioned word still used in Scotland to denote an elderly and rather rough sort of man. Originally it meant simply man, and the Saxon name Carl, from which we get Charles, came from it.

Courtesy: The Children's Encyclopedia, Vol. 5, Fleetway House, London

Editorial

Time-keeping by humans in social isolation

When I was requested to write an editorial on 'chronobiology' by the Editor, I thought I would briefly report my experiments and experience. In a DST project, I had investigated how human beings keep track of time when they live in total absence of time cues, at the Department of Animal Behaviour and Physiology, at the Madurai Kamaraj University in 1987-96. Fourteen human subjects (nine males and five females) participated in sixteen marathon experiments each lasting for 15 to 41 days. They spent time in silence and self-selected light or darkness, in an isolation facility 7.62 m x 7.62 m, without windows, but with ducted cool air and ventilation, fitted with all day-to-day requirements such as kitchenette, refrigerator, bathroom, cot and mattress, sitting table, chairs, a bicycle ergometer, cassette tape recorder, tapes, reading and writing material. There were no cues about day/night, and no personal contact. Most subjects cooked their own food; others were given food in bulk at irregular hours.

The following body functions were particularly investigated: i. sleep/wake, ii. rectal temperature, iii. estimation of presumed 2 hour intervals, iv. timing of menstrual cycle and v. meal timing. I briefly summarize our decade-long findings on human circadian rhythms in this bunker. i. Sleep/wake: All subjects underrated passage of time. In one dramatic case, a 24 year old female subject entered isolation on 4 May, 1989 and came out only on 8 June, 1989. She had been in social isolation for 35 calendar days, during which she went to sleep and woke up only 22 times. In her work diary, she had entered the date 26 May, 1989 on 8 June, 1989! Some of her 'free-running' subjective days could be 48 hours with sleep/wake ratios of 18:30 hours. ii. The rectal temperature rhythm (measured from nightly minimum to next nightly minimum) remained conservative and showed periods of 24.7 to 25.1 hours. Therefore the sleep/wake rhythm and the rectal temperature rhythm dissociate and drift apart. iii. The presumed 2 hour time estimation contracts and expands, like a time cystole, from values of 2 to 6 hours. The longer the subject stayed awake, the longer the estimated 2 hours. iv. Even though the female human subject went to sleep only 22 times in 35 days, the two episodes of her menstrual cycle were exactly 28 calendar days apart. The menstrual cycle is apparently not coupled to the sleep/wake clock, as is widely believed. This is a first report. v. Meal timings are coupled to the sleep/wake clock. Typically on days when subjects stayed up 30 hours, the time interval between breakfast and lunch would be 14 to 15 hours and the same between lunch and supper. These findings do not conform to intuitive expectations and have not yet been published. Working with human subjects is fun but arduous. A medical ethics committee (with a social worker, medical doctor, lawyer and psychiatrist) will scrutinize the details of planned experiments. India is the sixth country to have performed such experiments. None of the subjects in my experiments reported discomfort and only one experiment had to be discontinued owing to the subject contracting fever. One female subject participated in three experiments lasting 35, 39 and 41 days, setting up a world record.

M.K. CHANDRASHEKARAN

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ESTIMATING THE DENSITY OF PORCUPINES IN SEMI-ARID SARISKA VALLEY, WESTERN INDIA[1]

DIWAKAR SHARMA[2]

(*With three text-figures*)

Key words: Indirect estimates, direct estimates, dung decay, pellet groups, defecation

The population of the Indian crested porcupine (*Hystrix indica)* was estimated over a period of 3 months (May-July 1989) in semi-arid Sariska valley in the Sariska Tiger Reserve, Rajasthan. The methods included count of pellet groups in four transects each in three vegetation types, and direct counts of animals in a vehicle at night. The data collection using these two approaches was repeated 17 times. Calculation of density for indirect estimates involved data on the pellet decay rate and the defecation rate (of captive animals). The animal density was estimated to be 8.8 ±2.4 animals/ sq. km through direct count, while pellet group count provided an estimate of 12.4 animals/ sq. km with a variation of 0.9 to 24.9 animals/ sq. km in different habitats. The influence of some factors such as possible use of latrine sites and slow decomposition rate on density estimates are discussed.

INTRODUCTION

To estimate the population density of animals in the wild, quantifying faecal matter abundance, decay and defecation rate is considered to be useful and convenient (Neff 1968, Rowland *et al.* 1984). Although a number of studies have been conducted elsewhere (Putman 1984, Koster and Hart 1988), in India only a few studies have estimated the population of wild animals using this method (Sale *et al.* 1990, Dekker *et al.* 1991).

The Indian crested porcupine *Hystrix indica* Kerr is a nocturnal animal that reportedly feeds on crops (Alkon 1983, Gutterman 1987, 1988) and on the bark of trees (Choudhry and Ahmad 1975, Sharma and Prasad 1992). In spite of its economic importance, few estimates of its population density in the wild are available. Being nocturnal, small in size and shy of humans, it is hard to observe and very difficult to estimate its population. Therefore, methods involving indirect evidence can be very useful for estimation of its population. During the summer of 1988, the last of three consecutive drought years, comparatively large numbers of porcupines were seen in Sariska valley in the Sariska Tiger Reserve. This was a unique opportunity to estimate its population using direct sighting and faecal abundance.

The aim of this study was to estimate porcupine density using pellet group density, and to compare the results with that obtained using direct observations.

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Study Area

Sariska Tiger Reserve (27° 20' N and 76° 25' E) is a dry deciduous forest (Champion and Seth 1968) located in the semi-arid tract of Rajasthan in western India. The weather is dry and hot during the day throughout the year, barring the monsoon when it is hot and humid. There are three distinct seasons: winter (November-February, with night temperature as low as 3 °C), summer (March-June, day temperature up to 47 °C) and monsoon (July-October). Average annual rainfall is *c.* 650 mm, most of which falls between July and September.

The study was conducted between May and July 1989 in the Sariska valley (Fig. 1). The vegetation of the study sites consisted of *Ziziphus* scrubland, mixed woodland and *Ziziphus* woodland (Sharma and Prasad 1992). The hills surrounding the valley had forests dominated by *Anogeissus pendula* and were little used by the porcupine (Sharma and Prasad 1992). There was

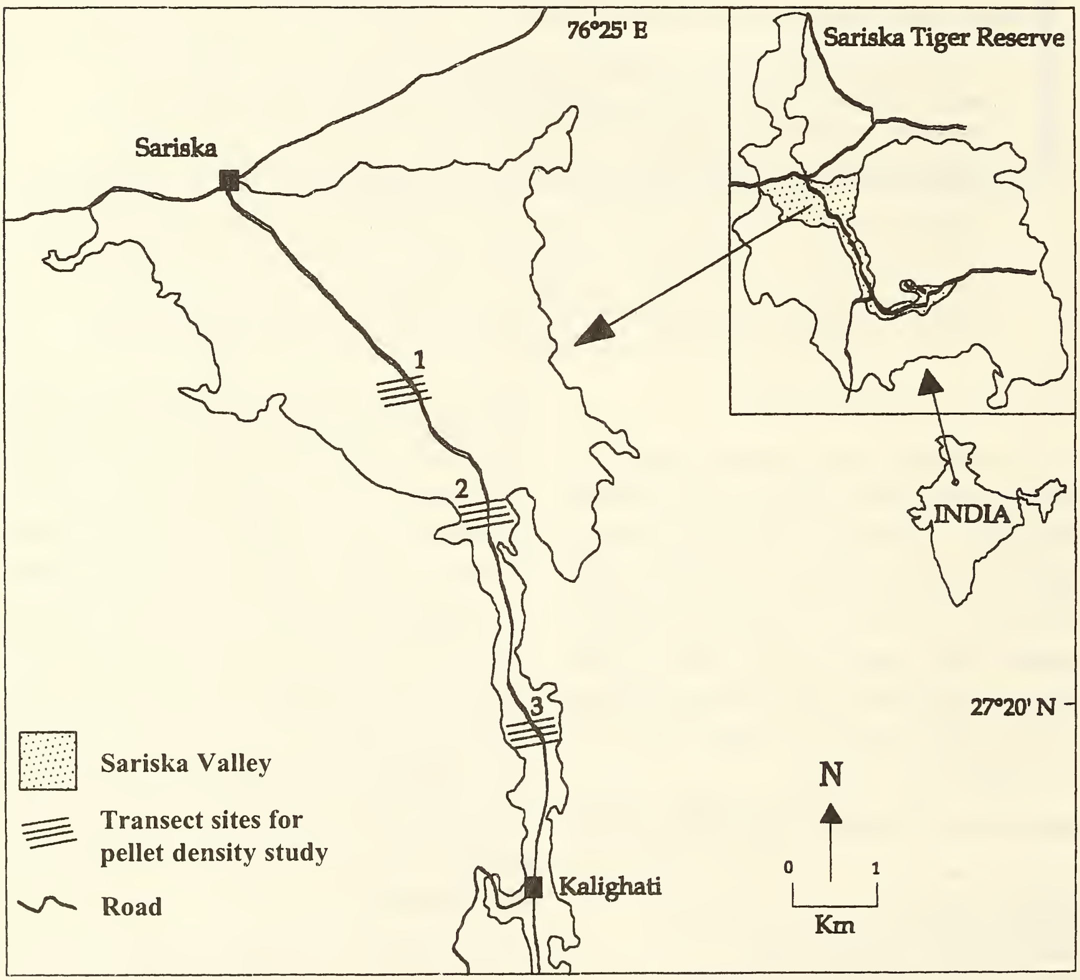

Fig. 1: Sariska valley showing the study sites

very little ground cover and litter in the three vegetation types during the study period.

The major mammals in the Sariska National Park include tiger (*Panthera tigris*), leopard (*P. pardus*), nilgai (*Boselaphus tragocamelus*), sambar (*Cervus unicolor*), chital (*Axis axis*), wild pig (*Sus scrofa*) and four-horned antelope (*Tetracerus quadricornis*). The density of animals, particularly of ungulates, is higher in Sariska valley, due to better habitat, than in other areas of the Tiger Reserve.

Methods

Direct Density Estimates

Since porcupines are nocturnal, they were counted at night using vehicle transects (Rodgers 1991), along a 10 km long road (Sariska to Kalighati), in Sariska valley. In June and July, the census was done 17 times, between 2000 to 2030 hrs, by four observers, in a jeep driven at a uniform speed of 20 km/hr. The animals seen in the headlights of the vehicle were recorded. The field covered by the headlights was 10 m on either side of the road. Porcupine density (D) was calculated using the fixed-width transect method (Rodgers 1991).

$$D = \frac{N}{2.L.B}$$

Where,
N = number of animals observed,
L = length of the transect in km, and
B = width on one side of the transect in km.

Indirect Density Estimates

Porcupine density (N) based on pellet group count, defecation and decay rate was calculated using the following equation (Barnes and Jensen 1987)

$$N = \frac{Y.r}{D}$$

Where,
Y = mean pellet group density (no./sq. km)
r = mean decay rate per day
D = mean defecation rate per day

Pellet group density: Porcupines defecate spindle shaped pellets, which are about 1-1.5 cm in diameter and 3-5 cm in length. The pellet number may range from 5-25 in a pellet group. Pellets groups were counted in strip transects in the three vegetation types, selected under stratified random sampling. Four strip transects 500 x 2 m were placed parallel to each other at 100 m intervals in each vegetation type (Fig. 1). Each transect was visited 17 times during May-June. The number of pellet groups that were available at the end of the study period after their accumulation and decay in each vegetation type was used to calculate the pellet group density i.e. the number of pellet groups per sq. km.

Pellet decay rate: Investigations of the decay rate of pellets were carried out from the first week of May 1989 to the second week of July 1989. Fresh pellet groups were located between May 10 and June 30. Eight groups of fresh pellets encountered were marked, counted and their condition monitored once a week. Two periods i.e. summer (May to mid-June) and pre-monsoon (mid-June to mid-July) were chosen to compare the seasonal decay rates.

The following equation was used (Barnes and Jensen 1987, Sukumar *et al.* 1991) to estimate the decay rate for pellet.

$$r = \frac{\ln(N_t)-\ln(N_{t-1})}{t}$$

Where,
r = mean decay rate of pellet groups per day,
N_t = number of pellet groups of one week,
N_{t-1} = the number of pellet groups of previous week, and
t = time (in days).

Defecation Rate: Two porcupines were observed in the National Zoological Park, New Delhi for 15 days, one in Sakkarbagh Zoo, Junagadh, for 19 days (in 1992) and another in Sayajibaug Zoo in Vadodara for 21 days (in 2000) and their pellet groups counted. The defecation rate was calculated as the number of pellet groups defecated per day.

Data was analysed using computer software. Non-parametric statistical tests were conducted for significance of results. Kruskal-Wallis tests were used to determine significance of variation among the three vegetation types, while Mann-Whitney U statistics were used to determine the significance of variation between the two seasons.

TABLE 1
DIRECT AND INDIRECT DENSITY ESTIMATES FOR PORCUPINE IN DIFFERENT HABITATS

Vegetation type	Pellet density (No./km^2)	Animal density (No./km^2) Direct	Animal density (No./km^2) Indirect	Shrub density (No./ha)
Ziziphus scrubland	9975	2.35 ±2.16	24.9	411 ±114
Ziziphus woodland	350	6.56 ±1.04	0.9	137 ±63
Mixed woodland	5075	17.6 ±4.02	12.7	79 ±55
Average	5133	8.8 ±2.4	12.8	206 ±77

RESULTS

Pellet Group Density

There was a significant difference in the pellet group density among the three vegetation types (K-W tests χ^2=16.15, p<0.001, n=34) (Table 1).

Pellet Decay Rate

The pellet condition was categorised into five age groups (Table 2). Pellets observed from June onwards (after pre-monsoon showers) also disintegrated through the same categories, but the decay was faster in the second category.

Results indicated a large variation in the decay rates of different pellet groups within a season. Trampling by large mammals such as wild pig, sambar, chital and nilgai accelerated the process. On the other hand the pellets not trampled by large mammals were present even 60 days after being defecated in a moist environment. No termite action was observed in summer.

TABLE 2
PORCUPINE PELLET DECAY IN SUMMER (MAY TO MID-JUNE) AND PRE-MONSOON (MID-JUNE TO MID-JULY)

S. No.	Time (days) Summer	Time (days) Pre-monsoon	Condition
1	< 1	< 1	Fresh, moist, covered with mucous, intact.
2	1-7	1-7	Intact, but dry.
3	8-30	8-15	Dry with cracks over the surface; more than 75% pellets distinguishable.
4	30-45	15-30	Cracks widen and colour becomes dark; about 50% or more still distinguishable.
5a		30-45	All pellets disintegrate.
5b	>45		Less than 50% distinguishable.

The pellet decay rate is shown in Figs 2 and 3. Table 3 shows the decay rate for various pellet groups monitored during summer and pre-monsoon. The average decay rate during summer was 0.005 per day. This rate increased to more than twice, 0.011 per day during pre-monsoon. The difference in the mean decay rates between summer and pre-monsoon was significant (M-W tests Z = 2.31, 2 tailed p<0.02, $n_{1,2}$ = 27,19). For calculation of animal density, only the decay rate during summer (May-June) are considered, as pellet group densities were estimated only in this season.

Defecation Rate

In the wild, the pellets were spindle shaped and discrete; while in the New Delhi zoo the pellets in a group were not as discrete. In Sakkarbagh Zoo (Junagadh) and Sayajibaug Zoo

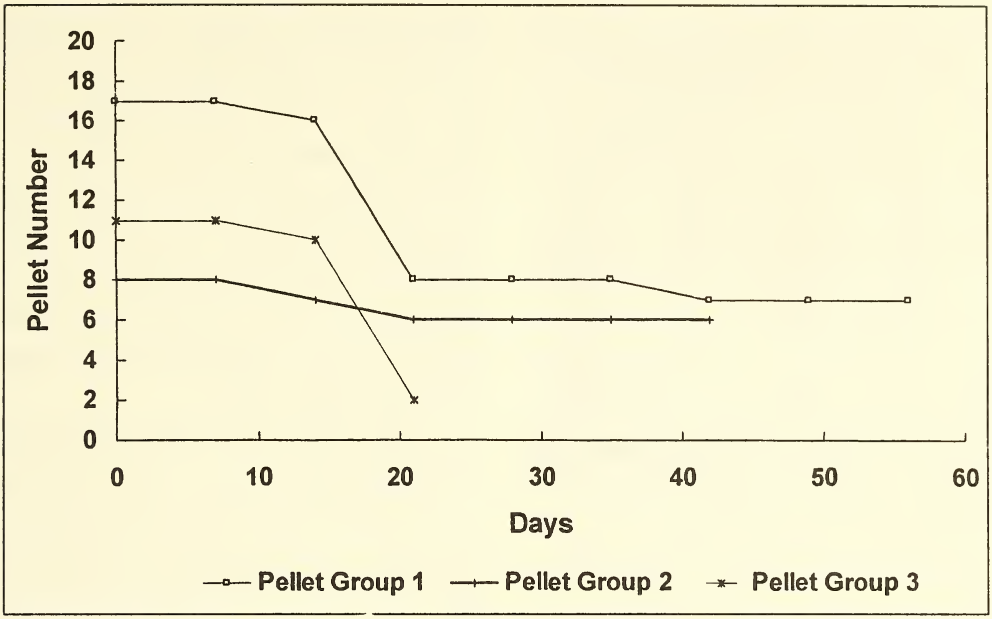

Fig. 2: Decay rate of porcupine pellets during summer

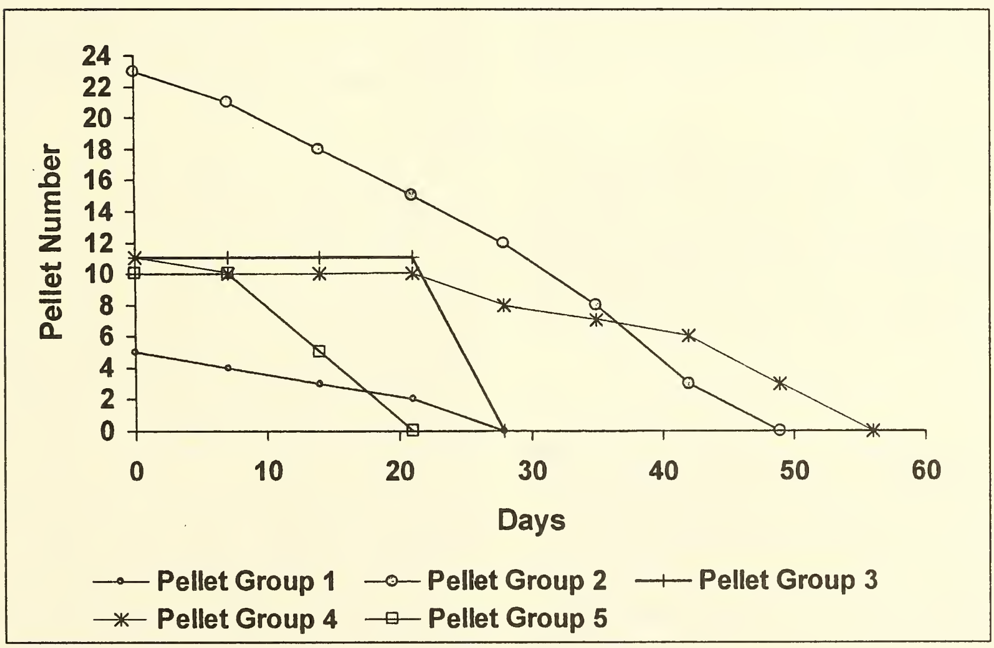

Fig. 3: Decay rate of porcupine pellets during pre-monsoon

TABLE 3
DECAY RATES OF VARIOUS PELLET GROUPS MONITORED DURING SUMMER AND PRE-MONSOON PERIODS

Pellet	Summer (May to mid-June)		Pre-monsoon (mid-June to mid-July)	
Group No.	Pellet group size	Decay rate (per day)	Pellet group size	Decay rate (per day)
1	17	0.005	5	0.010
2	8	0.004	23	0.012
3	11	0.011	11	0.014
4			10	0.020
5			11	0.007
Mean		0.005		0.011

(Vadodara), because of near natural diet, the droppings were similar to those in the wild and were included for calculations. The diet (including access to water) in captivity is different from that in the wild, hence the defecation rates should be taken only as an approximation. If possible, the defecation rate should be estimated in natural or semi-natural conditions. Defecation rate of porcupine in captivity varied from once to thrice a day. The average defecation rate was 2 ±0.15 per day (n = 40).

Animal Density

The results showed a difference between the direct and indirect estimates of density in each vegetation type (Table 1). The overall density estimated by direct observation was 8.8 ±2.4 animals per sq. km, while the estimate using indirect method was 12.9 animals per sq. km.

DISCUSSION

The road used for vehicle census at night passed through three different vegetation types, each of which differed from the others in structure, composition, density and utility to the porcupine (Sharma and Prasad 1992). This resulted in variation in porcupine density among the vegetation types. Due to the impact of drought and livestock grazing, the vegetation along the road was similar to that away from it. Therefore, it was presumed that porcupine movement and distribution along the roads would be similar to those away from the road. The small width (20 m) of the transect precluded the chances of missing animals on it. Within each vegetation type, density estimates from vehicle census at night had low variation, except in the case of *Ziziphus* scrubland. Further, the overall low variation in average density of the animals in the study area was considered good to compare indirect estimates with it.

The higher decay rate in pre-monsoon season (mid-June to July) was due to the action of dung beetles and termites. This started within a week after the first shower in the beginning of June. However, on hard (red soil) and bare ground the disintegration by termites took longer time.

Fresh pellets were not monitored after the onset of monsoon in July because of rapid disintegration. Often within a day or two about 50% or more of the pellets changed into an amorphous mass. Further, dense undergrowth did not permit an easy search of fresh pellets. Since the weather is dry for 8 months, the data collected during this period is considered to be more useful.

The observed differences in density estimates for the two methods were perhaps related to the shrub cover in the three vegetation types. Earlier results (based on debarking, Sharma and Prasad 1992), show that the porcupines preferred mixed woodland, *Ziziphus* woodland followed by *Ziziphus* scrubland as habitats. One would, therefore, expect the animal abundance and pellet density to follow this pattern. While the direct counts conformed to this pattern, the pellet density and indirect counts followed the reverse trend. This suggests that while the porcupines preferred to feed in mixed woodland and *Ziziphus* woodland, they spent substantial time in the dense undergrowth of *Ziziphus* scrubland. In *Ziziphus* scrubland, the

shrub density was the highest, followed by *Ziziphus* woodland and mixed woodland (Table 1). Dense shrub provides escape cover for the porcupine (Prater 1993).

This pilot study attempted to validate the methods used for indirect animal density estimates. Eberhadt and Etten (1956), Etten and Bennet (1965), Neff (1968) and Putman (1984) have comprehensively reviewed the limitations and sources of error in such a study. As revealed in this case, the differences in density estimates between direct and indirect evidence strongly emphasise the need for a proper stratification of habitat, preferably after reconnaissance, followed by adequate sampling (Grieb 1958). The results indicate that to estimate the population of nocturnal animals such as porcupine, one should study all habitats including those that may be avoided by the animal (Neu *et al.* 1974).

Even though most of these factors were taken into account (Sharma 1989) the defecation behaviour of porcupine may have played an important role in the indirect density estimates. The droppings were clumped, and under natural conditions were observed at certain locations only, while in captivity the animals defecated in the corners of the cages. This indicates the possibility of use of latrine sites by these animals. If so, can this method be used for other animals that use latrine sites?

Moreover, the semi-arid climate seems to have played an important role in substantially slowing down the decay rate of pellets. Pellets of chital and sambar defecated in the previous year have been observed in Gir Wildlife Sanctuary and National Park in Gujarat by this author, indicating their slow decay rate in similar conditions. These aspects require more research and, perhaps, the inclusion of a correction factor in the calculation of densities in such conditions.

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■ ■ ■

DEVELOPMENT OF *HYLA ANNECTANS* JERDON, 1870 FROM NAGALAND, INDIA[1]

J. MEREN AO[2] AND SABITRY BORDOLOI[3]

(*With four plates*)

Key words: *Hyla annectans*, ontogenic stages, normal development, Nagaland, laboratory condition, metamorphosis

Hyla annectans breeds during May to July in temporary rain pools, terraced fields and other waterlogged areas (depth 5-7 cm). Normal development has been studied from the egg through metamorphosis for four breeding seasons (1996-2000) under laboratory conditions. The time required for completion of a life cycle varies under different weather conditions in the field. In the laboratory (16-22 °C) the frog completed its life cycle in 64 days, 14 hours.

INTRODUCTION

Studies on the successive ontogenic stages, to record the normal developmental table, are important in understanding the ecology of a species and for planning conservation measures.

Various authors (Dutta and Mohanty-Hejmadi 1976, Mohanty-Hejmadi and Dutta 1977, Agarwal and Niazi 1977, Roy and Khare 1978, Mohanty-Hejmadi *et al.* 1979, 1980, Kiyasetuo and Khare 1986, Dutta *et al.* (1990-91) have contributed to the study of normal developmental tables of Anuran amphibians in India.

In Nagaland (25° 15'-27° 4' N, 93° 20'-95° 15' E), *Hyla annectans* is distributed along the Borail range at various altitudes 1,400-2,440 m above msl. Average atmospheric temperature during breeding season ranges from 16.5-26.6 °C. Relative humidity ranges from 74.33-81.63%. Precipitation ranges from 128.23-428.33 mm. Water temperature varies from 14-28.5 °C. Breeding activity starts from the middle of April and lasts till July end. The frogs breed in water logged places like temporary ponds, rainpools, puddles and terraced paddy fields. Embryonic development was observed for a period of four breeding seasons (1996-2000). Laboratory rearing was carried out in the Department of Zoology, Kohima Science College, Kohima, Nagaland.

METHODOLOGY

Amplexing pairs were collected from the field and transferred to aquaria or glass containers with water, allowing only half of the body to be submerged. Amplexing lasts for 3-5 hours. Eggs are laid between 0100-0400 hrs in the aquaria as well as in the field. Development stages were fixed in 5% formaldehyde solution; measurements were taken from preserved specimens. Photographs for Plates 1-3 were taken from preserved specimens, while for Plate 4 live individuals were used.

OBSERVATIONS

Breeding activity starts from the middle of April (12.3-26.6 °C) with the males' breeding call. Females appear only after one or two

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showers. In early May, amplexing pairs were collected and kept in glass containers or aquaria. Eggs were laid in batches in the field. In the aquarium, due to the absence of vegetation or other substratum, the jelly capsules of the eggs adhered together to form a single mass. The number of eggs laid by one female ranged from 590-650. Culture was maintained in clean enamelled trays and 100 fertilized eggs were stocked in each tray to avoid over-crowding. They were reared in the laboratory at 16-22 °C. Larvae were fed with *Spirogyra,* which is common in the breeding habitats. Tadpoles were staged according to Gosner (1960).

The no. of individuals per tray (Stocking number = 100) was reduced with progressive developmental stages.

Embryonic stage

Forty samples were measured to record the mean size of each stage (1-46).

Fertilization stages

Stage 1: *Fertilized egg* (Age 0 hrs; length 1.52 mm) (Plate 1, Fig. 1). The egg is spherical. The animal pole is pigmented dark brown, paling to white at the vegetal pole.

Stage 2: *One cell stage* (Age 0.55 hrs; length 1.52 mm). A lightly pigmented area, the grey crescent appears between the animal and vegetal pole towards the pigmented hemisphere.

Cleavage stages

Stage 3: *Two cell stage* (Age 1.50 hrs; length 1.52 mm) (Plate 1, Fig. 2). The meridional cleavage furrow originating at the animal pole proceeds to the vegetal pole and divides the egg completely into two equal blastomeres.

Stage 4: *Four cell stage* (Age 2.20 hrs; length 1.52 mm) (Plate 1, Fig. 3). The second meridional furrow, which starts at the animal pole, extends to the vegetal pole at a right angle to the first.

Stage 5: *Eight cell stage* (Age 2.45 hrs; length 1.52 mm). The third cleavage is latitudinal, slightly above the equator, which forms eight blastomeres. The four smaller micromeres of the animal pole are pigmented dark brown, whereas the four bigger macromeres of the vegetal pole are unpigmented.

Stage 6: *Sixteen cell stage* (Age 3.20 hrs; length 1.52 mm) (Plate 1, Fig. 4). The cleavage furrow is vertical. First, the pigmented micromeres are divided into eight cells, resulting in twelve cells (i.e. 8 micromeres and 4 macromeres). This is followed by the division of the four unpigmented macromeres as the cleavage furrow reaches the vegetal pole, resulting in 16 cells altogether.

Stage 7: *Thirty-two cell stage* (Age 3.52 hrs; length 1.56 mm) (Plate 1, Fig. 5). The latitudinal cleavage furrows of the micromeres and macromeres bring about the formation of 16 micromeres and 16 macromeres.

Stage 8: *Mid blastula* (Age 7-54 hrs; length 1.56 mm) (Plate 1, Fig. 6). The number of cells increased to more than 64 cells. The blastomeres are more numerous and smaller than before. The surface of the animal pole resembles a cluster of beads.

Stage 9: *Late blastula* (Age 12.10 hrs; length 1.56 mm). The surface of the animal pole has a granular appearance, which gradually becomes smooth. The pigmented region extends over the vegetal pole, which marks the beginning of the epibolic movement of the micromeres onto the macromeres.

Gastrulation stages

Stage 10: *Crescent dorsal lip* (Age 15.05 hrs; length 1.56 mm) (Plate 1, Fig. 7). The dorsal lip of blastopore has formed and is crescent-shaped. The unpigmented zone of the vegetal hemisphere is reduced due to continued migration of the pigmented micromeres towards the vegetal pole.

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PLATE 1

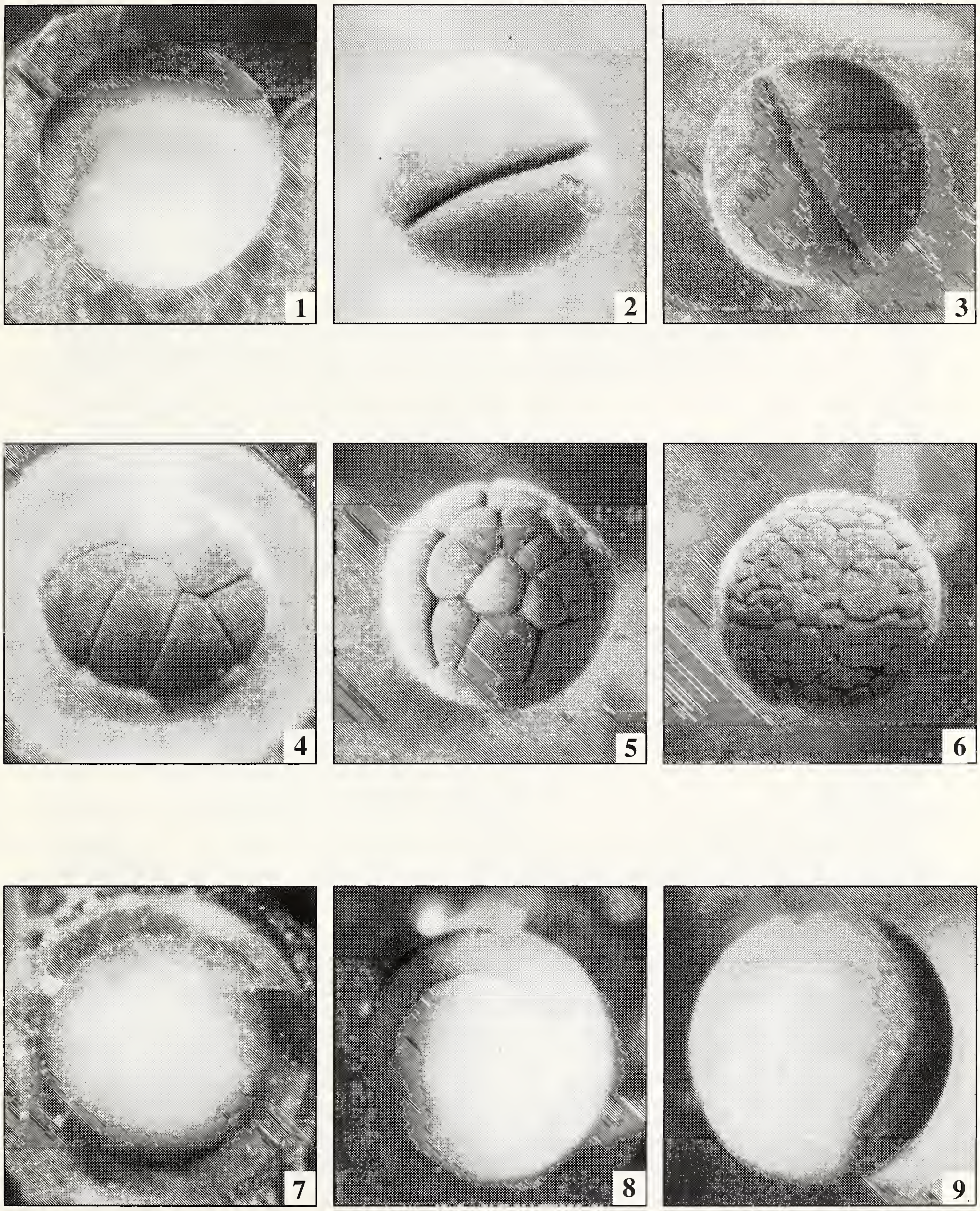

Fig.1 Fertilized egg, Fig. 2 Two cell stage, Fig. 3 Four cell stage, Fig. 4 Sixteen cell stage, Fig. 5 Thirty-two cell stage, Fig. 6 Mid blastula, Fig. 7 Crescent dorsal lip, Fig. 8 Horse-shoe shaped dorsal lip, Fig 9. Neural plate.

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PLATE 2

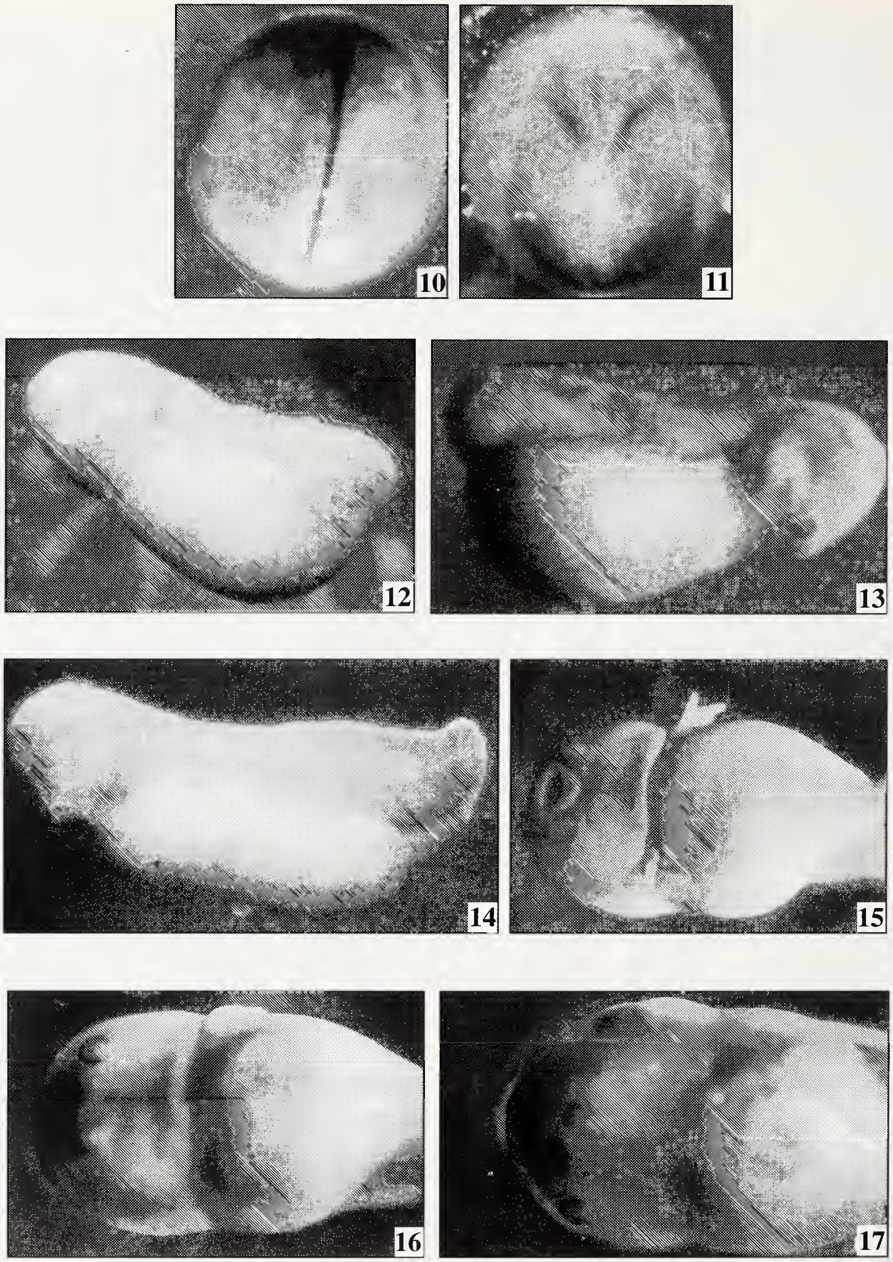


Fig. 10 Closure of neural fold, Fig. 11 Neural tube, Fig. 12, 13 Tail bud stage, Fig. 14 Muscular response stage, Fig. 15 Opercular stage, Fig. 16 Opercular fold of embryo closed on right side, Fig. 17 Operculum of embryo closed on left side

Stage 11: *Horse-shoe shaped dorsal lip* (Age 16.50 hrs; length 1.56 mm) (Plate 1, Fig. 8). The epibolic migration of micromeres over the vegetal pole reduces the exposed area of unpigmented macromeres, which is surrounded by the lateral lips of the semicircular or horse-shoe shaped blastopore.

Stage 12: *Small yolk plug* (Age 26.10 hrs; length 1.56 mm). The ventral lip of blastopore shifts to the posterior end. The uninvaginated macromeres, surrounded by the blastoporal lips, protrude a little and constitute the yolk plug.

Neurulation stages

Stage 13: *Neural plate* (Age 34.30 hrs; length 1.6 mm) (Plate 1, Fig. 9). The embryo is slightly elongated. The dorsal surface is flattened to form the neural plate, which is differentiated with the concentration of pigments along its borders.

Stage 14: *Neural fold* (Age 36.20 hrs; length 1.65 mm). The neural fold becomes distinct, with broad cerebral and narrow spinal cord regions of the neural plate. The neural folds gradually approach each other from blastopore to anterior region.

Stage 15: *Closure of neural fold* (Age 38.20 hrs; length 1.72 mm) (Plate 2, Fig. 10). The posterior end of the embryo becomes broader. The neural folds come closer and touch each other, both in the cerebral and spinal cord regions, forming a shallow neural groove, which is broader in the cerebral region.

Stage 16: *Neural tube* (Age 40.50 hrs; length 2.0 mm (Plate 2, Fig. 11) The neural folds have fused completely to form the neural tube, which is raised at the mid-dorsal ridge and demarcated by a darkly pigmented strand. The head and trunk are well marked. Gill plates appear as faint bulges. The increase in size of the embryo along with the associated vitelline capsule, is not accompanied by a similar increase in the length of the first envelope, and thus it ruptures at the anterior end.

Stage 17: *Tail bud stage* (Age 42.50 hrs; Trunk 2.44 mm; Tail 0.47 mm) (Plate 2, Figs. 12, 13). Tail bud appears at the posterior end of the embryo. It is wider than long, directed dorso-posteriorly and marked off from the body by a ventral notch. Stomodeal groove depression is slightly marked by a darker area. Bulges of the gill plates are distinct.

Stage 18: *Muscular response stage* (Age 60.00 hrs; Trunk 2.71 mm; Tail 0.75mm) (Plate 2, Fig. 14). Head region is well defined, with optic bulges and bulges of the gill plates. Oral suckers are indicated by two heavily pigmented elongated areas joined medially by a narrow lightly pigmented band below the stomodeum. Stomodeal depression is seen between the oral suckers. Due to gradual elongation of the embryo, the tail starts curving laterally to right or left, within the contour of the vitelline membrane.

Stage 19: *Heart beat stage* (Age 70.07 hrs; Trunk 3.10 mm; Tail 1.4 mm). Pulsation of heart is seen below and behind gill bud. Small pigmented depression at anterior end marks olfactory pit. Stomodeal depression becomes somewhat triangular. External gill buds prominent. Embryo coils to mechanical stimuli.

Stage 20: *Gill circulation stage* (Age 72.29 hrs; Trunk 3.28 mm; Tail 1.5 mm). Gills distinct, rudimentary branching at distal end. Oral suckers nipple-shaped. Stomodeal pit still a shallow triangular depression. Vitelline membrane becomes thin and weak. Anterior end of the head pressed against the vitelline membrane.

Post-embryonic development

Stage 21: *Larva hatched* (Age 102.29 hrs; Head and Trunk 3.2 mm; Tail 3.2 mm). The head causes a bulge in the vitelline membrane at the anterior end. At this point the membrane breaks and the larva emerges from the mass of jelly. Tail straight, tail fin dusky. Olfactory pit deepens, cornea begins to be transparent. Stomodeum now

a deep triangular pit, whose opening is the larval mouth.

Stage 22: *Tail fin circulation stage* (Age 117.29 hrs; Head and Trunk 3.4 mm; Tail 3.6 mm). Tail fin circulation starts at base of anterior part of dorsal fin, just above the trunk. Mouth slightly wider. Upper and lower labial fringes develop, but without papillation.

Stage 23: *Opercular fold stage* (Age 143.59 hrs; Head and Trunk 3.6 mm Tail 4.5 mm) (Plate 2, Fig. 15). Operculum covers bases of external gills. Jaws not keratinised. Upper and lower labial fringes develop papillae and faint labial ridges. Pigmentation on tail begins, cloaca not opened.

State 24: *Opercular fold of embryo closed on right side* (Age 172.29 hrs; Head and Trunk 3.7 mm; Tail 5.0 mm) (Plate 2, Fig. 16). Operculum closed on the right side. Labial jaws form supra- and infra-rostrodont. A faint row of upper supra-angular keratodont develops. Other characters as in Stage 23.

Stage 25: *Operculum of embryo closed on left side* (Age 185.29 hrs; Head and Trunk 4.2 mm; Tail 6.0 mm) (Plate 2, Fig. 17). Operculum closed and gills disappear; oral suckers diminishing. Spiracle formed. Tail lightly pigmented. Anal tube opens, tadpole starts feeding.

Stage 26: *Hind limb bud stage* (Age 356 hrs; Head and Trunk 7.0 mm; Tail 10.0 mm) (Plate 3, Fig. 18). Appearance of hind limb bud at a groove between the belly wall and base of tail on either side of cloacal tail piece. Length of limb bud less than half its diameter. Dental formula becomes 1:1 + 1/3. Pigmentation spreads to dorsal and anal fins.

Stage 27: *Length of limb bud equal to half its diameter* (Age 420 hrs; Head and Trunk 7.8 mm; Tail length 13.0 mm). Length of limb bud equal to half its diameter. The patches of pigmentation in the tail fin spread considerably.

Stage 28: *Length of limb bud equal to its diameter* (Age 514 hrs; Head and Trunk 8.4 mm; Tail 16.0 mm) (Plate 3, Fig. 19). Distal end of limb bud slightly conical.

Stage 29: *Length of limb bud is equal to one and half times its diameter* (Age 600 hrs; Head and Trunk 9.0 mm, Tail 18.0 mm). Distal end conical.

Stage 30: *Length of limb bud is equal to twice its diameter* (Age 684 hrs; Head and Trunk 11.0 mm, Tail 19.1 mm). Distal half of conical limb bud slightly bent ventrally. No pigmentation on limb bud.

Stage 31: *Foot paddle stage* (Age 748 hrs; Head and Trunk 11.5 mm; Tail 20.1 mm) (Plate 3, Fig. 20). The distal end of limb bud is flattened mediolaterally to form a foot paddle. Knee bend is prominent. Light pigmentation starts at outer base of limb bud.

Stage 32: *First indentation* (Age 813 hrs; Head and Trunk 12.0 mm; Tail 23.0 mm). The margin of the foot paddle becomes slightly indented on the dorsal side, which marks the prominences of the future 4th and 5th toes.

Stage 33: *Second indentation* (Age 853 hrs; Head and Trunk 12.8 mm; Tail 24.5 mm) (Plate 3, Fig. 21). The margin of the foot paddle becomes indented on the ventral side, behind the prominence of 4th toe, which marks the 3rd, 4th and 5th toes.

Stage 34: *Third indentation* (Age 890 hrs.; Head and Trunk 13.2 mm; Tail 26.0 mm) (Plate 3, Fig. 22). The margin of foot paddle becomes indented, on the ventral side, behind the prominence of 3rd toe, which marks the prominence of 2nd, 3rd, 4th and 5th toes.

Stage 35: *Fourth indentation* (Age 936 hrs; Head and Trunk 13.4 mm; Tail 26.4 mm.) (Plate 3, Fig. 23). The margin of the foot paddle is indented behind the 2nd toe demarcating the prominence of the 1st toe. All the five toes are separated from each other.

Stage 36: *Margin of 5th toe web directed towards the tip of 2nd toe* (Age 1019 hrs; Head and Trunk 13.6 mm; Tail 27.2 mm) (Plate 3,

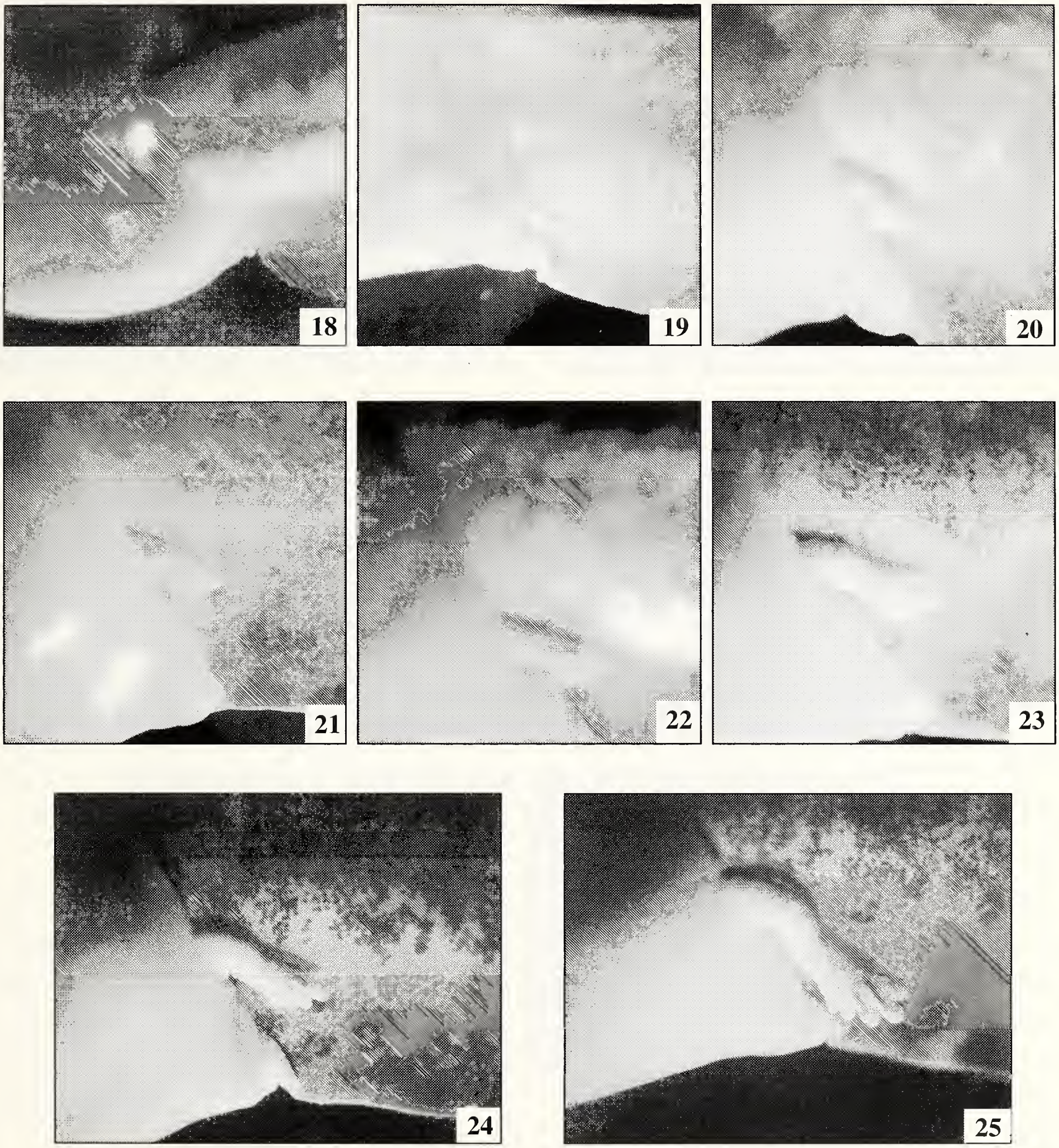
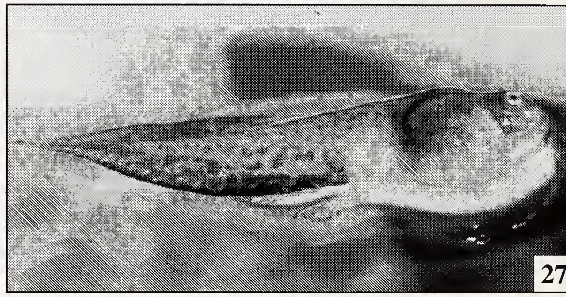
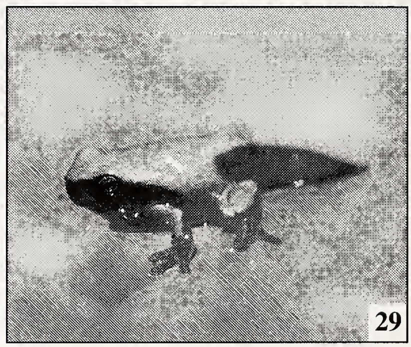
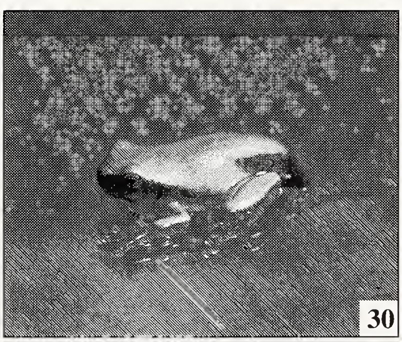


Fig. 18 Hind limb bud stage, Fig. 19 Length of limb bud equal to its diameter, Fig. 20 Foot paddle stage, Fig. 21 Second indentation, Fig. 22 Third indentation, Fig. 23 Fourth indentation, Fig. 24 Margin of 5th toe web directed towards the tip of 2nd toe, Fig. 25 Margin of 5th toe web directed towards prehallux.

Ao, J. Meren *et al.*: *Hyla annectans* Jerdon PLATE 4







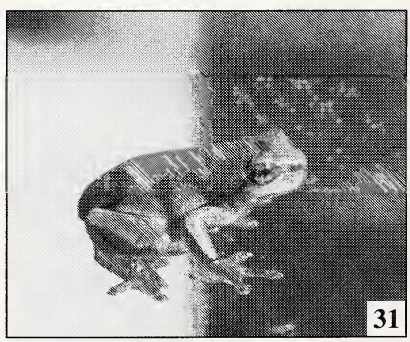


Fig. 26, 27 Cloacal tail piece reduced, Fig. 28 Both fore limbs emerged,
Fig. 29 Angle of mouth reached the middle of eye,
Fig. 30 Angle of mouth reached posterior margin of the eye, Fig. 31 Metamorphosed froglet.

Fig. 24). The margin of the 5th toe web is directed towards the tip of the 2nd toe.

Stage 37: *Margin of 5th toe web directed towards the tip of 1st toe* (Age 1084 hrs; Head and Trunk 13.7 mm; Tail 28.0 mm). The margin of the 5th toe web is directed towards the tip of the 1st toe. Pigmentation appears in the 4th and 5th toes along the foot. Toes are longer. A rudiment of prehallux is indicated by a light protuberance behind the 1st toe. Ventral surface of the foot is closer to the ventral fin.

Stage 38: *Margin of 5th toe web directed towards prehallux* (Age 1136 hrs; Head and Trunk 14.0 mm; Tail 29.00 mm). (Plate 3, Fig. 25). The margin of the 5th toe web is directed towards prehallux. Inner metatarsal turbercle appear as a small outgrowth. Pigmentation appears in 3rd, 4th and 5th toe along the foot.

Stage 39: *Appearance of subarticular tubercles in the toes* (Age 1210 hrs; Head and Trunk 14.3 mm; Tail 29.2 mm). Subarticular tubercles appear on the inner surface of the toes as light patches. The inner metatarsal tubercle becomes a small oval outgrowth.

Stage 40: *Toe pads complete* (Age 1274 hrs; Head and Trunk 14.4 mm; Tail 29.2 mm). Distal ends of the toes thickened. Subarticular tubercles are clearly elevated. The cloacal tail piece is not reduced.

Stage 41: *Cloacal tail piece reduced* (Age 1392 hrs; Head and Trunk 14.8 mm; Tail 30.0 mm. (Plate 4, Fig. 26, 27). The cloacal tail piece gets reduced and only a narrow strip remains over and in between bases of the thigh still attached with ventral fin distally. The fore limbs are visible through the skin. Green pigmentation of the dorsal surface begins. Tail not dark. Keratodonts start shedding. Oral papillae remain intact.

Stage 42: *Both fore limbs emerge* (Age 1422 hrs; Head and Trunk 14.5 mm; Tail 25.1 mm) (Plate 4, Fig. 28). Both fore limbs emerge, usually the right fore limb emerges first, followed after a few hours by the left. Resorbtion of the labial fringe begins, however angular papillae still remain as a small tuft on both corners of the mouth, which starts widening. The horny beak is shed. Tail starts darkening. The angle of the mouth is level with the nostril. The cloacal tail piece disappears at this stage, leaving the cloacal aperture free below.

Stage 43: *Angle of mouth between the eye and nostril* (Age 1434 hrs; Head and Trunk 14 mm; Tail 16.0 mm). The widening angle of mouth has reached a point midway between nostril and the anterior margin of eye. The tail becomes still darker, the dorsal and ventral fins shrink and the length of the tail is reduced, but still longer than the extended hind limb.

Stage 44: *Angle of mouth reached the middle of eye* (Age 1462 hrs; Head and Trunk 14.00 mm; Tail 5.0 mm (Plate 4, Fig. 29). The widening angle of the mouth has reached the level of the middle of the eye. Dorsal and ventral fins have disappeared. Tail resorbed considerably and is as long as the femur.

Stage 45: *Angle of the mouth reached posterior margin of the eye* (Age 1498 hrs; Head and Trunk 13.5 mm; Tail 1.0 mm) (Plate 4, Fig. 30). The widening angle of the mouth has reached the posterior margin of the eye. The tail is resorbed to a small triangular stub.

Stage 46: *Metamorphosed froglet* (Age 1550 hrs; Head and Trunk 13.5 mm; Tail 0.0 mm.) (Plate 4, Fig. 31). The triangular tail stub with dark tissue disappears completely.

Total time taken for completion of metamorphosis was 64 days 14 hours.

Discussion

Hamburger (1947), Gosner (1960), Rugh (1962), Nieuwkoop and Faber (1967) were referred for preparing the normal table. Gosner (1960) proposed 46 stages, with simplified criteria for staging developmental events in Pelobatids, Bufonids, Ranids and Hylids. In the

present study, the development of *Hyla annectans* *was* divided into these 46 stages. Certain variations have been noted in the development of *Hyla annectans*.

Developmental, stages have been divided into fifteen major subheadings (1) Fertilization two stages (2) Cleavage seven stages (3) Gastrula three stages (4) Neurula four stages (5) Tail bud one stage (6) Muscular response one stage (7) Heart beat one stage (8) Gill circulation one stage (9) Cornea becoming transparent one stage (10) Tail fin circulation one stage (11) Operculum formation three stages (12) Hind limb bud five stages (13) Identation and development of toes ten stages (14) Cloacal tail piece reduced one stage (15) Metamorphosis climax five stages.

Characteristic features of development include the tail bud, initially indicated by a strong upward arching of the dorsum. Hatching of the embryos occur in stage 21, when the cornea just begins to be transparent. However, the cornea becomes fully clear only towards the end of stage 22 and beginning of stage 23. At stage 22, the circulation in the tail fin begins, but the tail fin is not transparent as in Gosner series and remains dusky. Narrow cloacal tail piece persists, in Gosner series - 41 which, however, disappears only in stage 42 when both forelimbs have emerged. Rostrodont and keratodonts are shed completely at stage 42.

Acknowledgement

This paper is dedicated to the memory of Late Prof. Mahendra Kumar Khare, who initiated research in Developmental Biology in the North Eastern Hill University, Shillong, Meghalaya, India.

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NEST-SITE SELECTION OF WHITE-BROWED FANTAIL *RHIPIDURA AUREOLA* IN MUDUMALAI WILDLIFE SANCTUARY[1]

V. GOKULA[2]

Key words: White-browed fantail, *Rhipidura aureola*, foraging, breeding, nest-site characteristics

Nesting and nest-site selection of white-browed fantail (*Rhipidura aureola*) were studied in Mudumalai Wildlife Sanctuary (WLS), south India, during 1995-1997. In addition, foraging pattern was studied as it may also explain nest-site selection. A total of 73 foraging records were obtained with no reference to age and sex. Sallying was the predominant foraging manoeuvre used to catch insect food. A total of 24 nests were located on two tree species: *Anogeissus latifolia* (83%) followed by *Elaeodendron glaucum* (17%). The results indicated that the fantail did not select nest sites randomly in Mudumalai WLS, but had specific nesting requirements. It generally selected a patch with high tree density, with less to moderate ground cover to construct the nest.

INTRODUCTION

Nest-site selection involves discrimination among alternative sites that provide different sets of circumstances affecting survival and reproduction. Hence, it is an important decision to be made by birds. However, nest-site selection of the majority of bird species in India is poorly studied. An attempt was made to understand the nest-site selection of white-browed fantail (*Rhipidura aureola*). Although the white-browed fantail is widely distributed in India, only the species description is given by Ali and Ripley (1987). No detailed information is available on its ecology. This study describes the foraging, nesting, breeding, and nest-site selection of the white-browed fantail in Mudumalai WLS during 1995-1997.

STUDY AREA

The Mudumalai WLS is located at 11° 30' to 11° 39' N and 76° 27' to 76° 43' E in the Nilgiri district, Tamil Nadu. It has an average elevation of 1,000 m. The climate is moderate, and temperature varies from 14-17 °C during December-January and 29-33 °C during March-May. The annual rainfall, received in two periods, varies from 600 to 2,000 mm. The high rainfall period (June-August) is brought by the southwest monsoon, while the low rainfall period (September-November) comes from the northeast monsoon. The Sanctuary is drained mainly by the perennial river Moyar and partly by various seasonal rivers. In corresponding to the rainfall, the vegetation varies from thorn forest in the east to semi-evergreen forest in the west. Further details of the study area are given by Desai (1991).

The study was carried out in a 20 ha plot dominated by plant species such as *Anogeissus latifolia*, *Acacia* spp. (including *A. chundra*, *A. leucophloea* and *A. ferruginea*), *Ziziphus* spp., *Sapindus emarginatus*, *Phyllanthus emblica*, *Erythroxylum monogynum*, *Cassia fistula*, *Elaeodendron glaucan* and *Capparis* spp.

METHODS

Foraging ecology: Foraging records were collected at the study site during January to April (dry spell in 1995 and 1996) as the white-browed fantail breeds only during this period. Records

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were collected within the first four hours after sunrise. Only one foraging record (initial record) was taken from any individual encountered, as done by MacNally (1994).

For each foraging attempt the following were recorded :

(a) Height above ground level: ground, and at every 1 m interval up to 10 m.

(b) Foraging methods: 1. gleaning: a stationary food item is picked from its substrate by a standing or hopping bird; 2. probing: similar to gleaning, only the bird's beak penetrates or lifts the substrate to locate concealed food; 3. pouncing: the bird flies from a perch and grabs the food item as it lands on the substrate; and 4. sallying or flycatching: a bird flies into the air to catch flying prey.

(c) Substrate: 1. ground, including debris, litter and grass; 2. trunk/main branches, the main axes of trees; 3. foliage, leaves including leaf blades and petioles; and 4. twigs, small branches <1 cm in diameter to which leaves were attached, and 5. air.

Nesting and Nest-Site Selection: A 20 ha plot was laid for nest-site selection studies. Searches were made on foot for nest structures by observing substrate suitable for nesting (ground, rock, holes etc.). A nest was corroborated if adults were observed performing breeding activities (nest building or renovation, incubation, feeding the young) in or adjacent to the nest. Regular visits were made to collect breeding information.

The method of determining nest-site selection followed are similar to the established ones by Bechard *et al.* 1990 and Hullsieg and Becker 1990. Variables were set at three levels. The shape and size (physical structure) of different nests were recorded. Among the variables "nest concealment" was estimated by viewing the nest from above or below or at nest level from a distance of 2m, 5m, 7m and 10m from all four cardinal points (Martin and Roper 1988). Concealment of the nest was estimated using abundance rating (0-4=very high, >4-8=high, >8-12=low and >12-16=very low).

The nest-tree or substrate variables were recorded to identify the key factor of the nest-plant that is responsible for supporting a particular species nest. It includes: 1. tree species 2. tree height, and 3. girth at breast height (GBH).

The nest-patch variables were measured within a 0.07 ha circular plot centred at the nest tree as suggested by Titus and Mosher (1981). A "nest-patch" was defined as the area surrounding a nest tree, including vegetation and topographic features used by a nesting pair during the entire nesting season exclusive of foraging areas (Reynolds *et al.* 1982). This would help to identify the microhabitat required for nesting of bird species. The variables noted were: ground cover, shrub cover, canopy cover, distance to disturbance and road. Percentage of vegetation cover (shrub and ground) was visually estimated. The percent canopy cover immediately over the nest was measured using a hand mirror marked with a grid. The shaded area was estimated as canopy cover (Martin and Roper 1988).

To test for selection, all parameters except nest measurements were compared with similar measurements at randomly selected sites. The 20 ha plot laid for nest-searches in each habitat was divided into 80 grids (50 m x 50 m). Grids were plotted and numbered on an enlarged topographic map of the study area. 20 grids were selected from the 80 grids by using lot method. Once the approximate grid or site was located, the nearest tree or shrub was made the centre of a random plot. Except for nest measurements, all other variables (nest-tree and nest-patch) were enumerated from the plot.

Statistical Analyses: Univariate analyses of variances (ANOVA), Mann-Whitney U, and other simple statistics (Mean and SD) were used where appropriate (Sokal and Rohif 1981). Results are reported as significant if they are

associated with a value of P<0.05. The SPSS software was used for data analysis.

Results and Discussion

Foraging Pattern: A total of 73 foraging observations were made. Present sample size was assumed to be sufficient, as 30 independent observations are recommended to represent the behaviour of a bird accurately by Morrison (1984). White-browed fantails used foraging manoeuvres namely sally, pounce and glean to catch insects (Table 1). Of the three manoeuvres, sally was predominant. Among different forms of sally, the fantail predominantly used sub-canopy sally. It foraged over a wide range from the ground up to 8 m above ground level. However, the majority of foraging attempts were made at 4-5 m above ground level (72%). Insects were largely caught in flight.

Breeding Biology: Breeding activity started soon after the blossom shower in April and extended to May. A greater number of active nests were seen during the first week of April (n=18), and these numbers decreased towards May. A fantail took four to five days to construct a nest (three cases). Mainly, they laid three eggs (n= 19), but clutch size varied from two to three eggs. The mean incubation period and nestling period were 14.5 ±0.53 (8 pairs) and 16.5 ±0.57 (4 pairs) days respectively.

Nest Morphology: The nests were neatly built, cup-shaped, and often placed on a horizontal fork. Only fine grass and rootlets were used as nesting materials. The structure of the nest was as recorded by Ali and Ripley (1987). The mean depth and diameter of the nests were 2.98 cm and 5.6 cm respectively (Table 2). Nests were placed at a mean height of 4.71 m from ground level, varying from 3 m to 5.67 m. Girth of the nest-plant varied from 57 to 167 cm. The nests were hardly visible from a distance as their size was very small and the colour merged with the tree colour.

Nest-Tree Selection: White-browed fantail used only trees for building their nest. Greater heights required may be the reason for this selection. Only two plant species were used and the majority of the nests were on *Anogeissus latifolia* (83%) followed by *Elaeodendron glaucum* (17%). All the nests were built only on twigs on the outer edge of the lower canopy. The selection of *Anogeissus latifolia* can be attributed to two factors: the colour of the nest is similar to the bark of the tree species, protecting it from predators, and *A. latifolia* was more abundant (5.2 /ha) than *Elaeodendron glaucum* (2.3 /ha) in the study area. In addition, the plant architecture (branching geometry) of these two tree species may also be a factor, as it gives

Table 1
FORAGING MANOEUVRES OF THE WHITE-BROWED FANTAIL

Foraging substrates (%)							
Air	Ground	Foliage					
70	28.5	1.5					
Foraging height (%)							
G	0-1m	>1-2m	>2-3m	>3-4m	>4-5m	>5-6m	>7-8m
28	11.5	9	8	9.5	19	13	2
Foraging method (%)							
CS	SS	BS	GS	GP	FG		
3	56.5	10.5	19	9.5	1.5		

G = Ground, CS = above canopy sally, SS = subcanopy sally, BS = bush sally, GS = ground sally, GP = ground pounce, FG = foliage gleaning

TABLE 2
NEST-SITE CHARACTERISTICS OF THE WHITE-BROWED FANTAIL

Variables	Mean (n = 24)	SD
Nest tree height (m)	7.52	0.90
Nest tree GBH (cm)	98.85	31.10
Nest height (cm)	471.80	64.97
% Ground cover	46.00	19.97
% Shrub cover	25.75	14.60
% Shade over nest	83.00	16.23
Nest depth (cm)	2.98	0.11
Total nest diameter (cm)	5.60	0.13
Interior diameter (cm)	5.00	0.17
Distance to the next tree (m)	3.29	1.36
Distance to the road (m)	540.50	538.37
% Disturbance of nest tree	0.00	0.00
Nest concealment	2.05	1.15

structural support to the nest.

Nest-Site Selection: The nest-site differed from the random site in the following aspects: ground cover (u=59.5 p<0.01), canopy cover (u=52.5 p<0.01), tree GBH (F=32.9 p<0.01) and tree density (F=10.3 p<0.01) (Table 3).

For nesting, the fantail generally selected a patch with high tree density, less canopy cover, and less to moderate ground cover. A patch with high tree density and less canopy cover was possible, as majority of the trees shed their leaves when this flycatcher nests. More potential nest sites near a nest may reduce predator efficiency, as predators would be forced to search more sites to find a nest (Martin 1988, Martin and Roper 1988). The tendency to choose patches with more trees may reflect this choice. In many cases, nests were built in exactly the same place or branch in subsequent years. Site-fidelity is advantageous to the bird as it becomes familiar with the area; this may enhance foraging success, predator avoidance, defence and other behaviour which contributes to reproductive performance (Newton and Wyllie 1992).

TABLE 3
COMPARISON OF NEST-SITE VARIABLES OF WHITE-BROWED FANTAIL WITH RANDOM SITES

Parameters	Nest-site (n = 24)	Random site (n = 20)	P
Tree Height	7.52 ±0.90	7.0 ±4.82	ns
Tree GBH	98.85 ±31.1	51.05 ±20.40	0.00
Tree Density	5.40 ±0.89	4.15 ±2.03	0.00
Ground Cover	46.00 ±19.97	83.50 ±32.97	0.00
Shrub Cover	25.75 ±14.60	29.50 ±28.56	ns
Canopy Cover	37.20 ±16.34	78.50 ±22.95	0.00
Distance to Road	540.50 ±583.3	567.95 ±636.10	ns

ns = not significant. Details of the statistical tests are given in the text.

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SOME CHELONIAN RECORDS FROM MIZORAM[1]

Anwaruddin Choudhury[2]

(*With one text figure*)

Key words: Turtles, tortoises, chelonians, conservation, Mizoram, northeastern India

During a survey in the northeastern Indian state of Mizoram, six species of turtles and tortoises were recorded. These are the elongated tortoise *Indotestudo elongata*, brown hill tortoise *Manouria emys*, Asian leaf turtle *Cyclemys oldhamii,* keeled box turtle *Pyxidea mouhotii*, Indian roofed turtle *Kachuga tecta* and the Indian tent turtle *Kachuga tentoria.* Unidentified softshell turtles have also been recorded. Since this was the first survey, all records are new for the area. All species of chelonians are eaten by the local tribals, making conservation efforts difficult. However, some are protected in the notified wildlife sanctuaries and national parks. Expansion of human habitation, destruction of habitat for *jhum* (shifting cultivation as practiced by the hill tribes), and poaching for meat are the main conservation problems. The reported trade in turtle shells across the Indo-Myanmar international boundary is, however, going to become a matter of concern in the future. Recommendations have been made for conservation.

Introduction

The state of Mizoram (21° 58'-24° 30' N, 92° 16'-93° 25' E; area 21,081 sq. km) is located in the southern part of northeastern India (Fig. 1). Formerly referred to as the Lushai Hills of southern Assam, a part of the Himalayan system, the entire state is hilly. The terrain is dissected mostly by north-south flowing rivers making a series of parallel ranges. The highest ranges are towards the east, with the Phawngpui or Blue Mountain (2,157 m above msl) and Lengteng (2,141 m above msl) peaks. The lowest elevation is in the riverbeds near the Assam-Mizoram and India-Bangladesh border (less than 100 m above msl).

The chelonian fauna of the state was virtually unknown, and the literature on the region as well as on India's turtles and tortoises has virtually no reference to this area (Anderson 1871, Choudhury 1990, 1996a, b, 1998, Das 1985, 1990, 1991, 1995, Smith 1931).

The present account describes the records of turtles and tortoises discovered during my field survey (April 2000) in Aizawl, Mamit, Kolasib, Serchip, Lunglei, Lawngtlai and Saiha districts.

Abbreviations: SCL = straight carapace length, CCL = curved carapace length, SCW = straight carapace width, CCW = curved carapace width, CH = carapace height, PL = plastron length, PW = plastron width, SH = shell height.

Local names: *Sartle* (Mizo), *Sattle* (Lai or Pawi, especially in Lawngtlai and Saiha districts), and *Seilka* (Mara or Lakher, especially in Saiha district).

Study Area

The study sites were: Dampa Tiger Reserve, Dapchua village, Khawmawi village, Mampui village, Ngengpui village, Ngengpui Wildlife Sanctuary, Phura village, Palak Dil wetlands, Saiha, Sangau village, Thaltlang village and Phawngpui National Park (Fig. 1).

Dampa Tiger Reserve (500 sq. km), located in Mamit district, comprises of low hills with elevations of 150 to 1,000 m above msl. Vegetation is mostly tropical wet evergreen and semi-evergreen with bamboos. The fringe area is degraded due to currently used as well as abandoned *jhums*. Dapchua village is on the banks of the Tut (Gutur) river, a tributary of the

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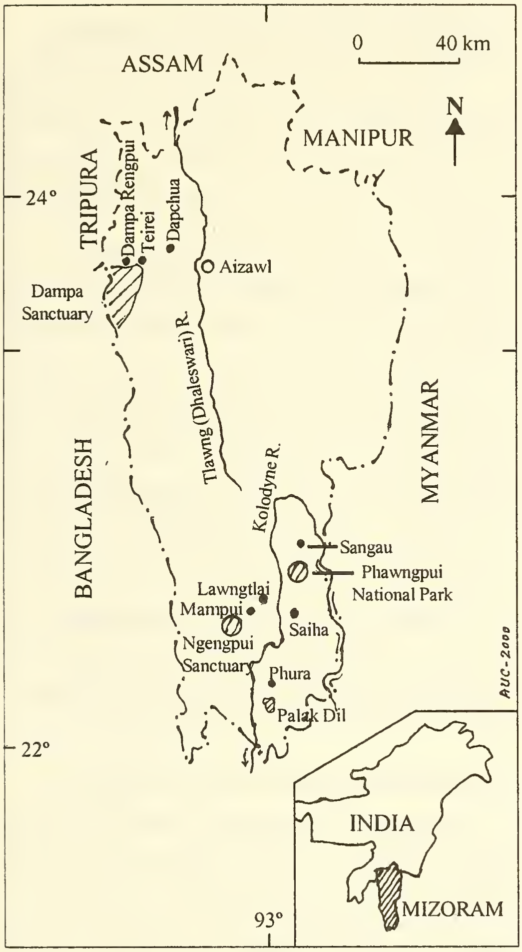

Fig. 1: Map of Mizoram showing the study sites

Tlawng or Dhaleswari River, about 150 m above msl, also in Mamit district. On both sides of the river, hill ranges rise to over 500 m above msl.

Khawmawi (Lunglei district), and Ngengpui (Lawngtlai district) villages are on the valley (150 m above msl) of Ngengpui River, a tributary of the Kolodyne River, in the northern fringe of Ngengpui Wildlife Sanctuary. Some of the finest rainforests of Mizoram are still found in this area (elevation 100-500 m above msl). The Sanctuary is 110 sq. km in Lawngtlai district. Mampui village, not far from Ngengpui Sanctuary, is also in Lawngtlai district, but much higher (1,000 m above msl). Some fine patches of evergreen forest amidst *jhum* is typical of the vegetation.

Phura village and Palak Dil wetlands are located in the southern part of Saiha district. The former is a valley (200 m above msl) surrounded by hills (>400 m above msl), and the latter a natural lake (*c.* 1 sq. km at 300 m above msl). Some of the forest patches are still excellent, but *jhum* is widely practised here.

Saiha is the headquarters of Saiha district (1,100 m above msl) and is surrounded by degraded hillslopes with grass or scrub. Sangau (1,350 m above msl) and Thaltlang (1,300 m above msl) villages are near Phawngpui National Park (50 sq. km). The Park ranges from 1,100 to more than 2,000 m above msl, and has the highest peak in Mizoram (2,157 m above msl). Habitat in the lower areas (<1,600 m above msl) is tropical evergreen and higher up it is subtropical broadleaf. Towards east flows the Kolodyne River (*c.* 300 m above msl), which also marks the boundary between India and Myanmar at that stretch.

The climate of these areas is tropical monsoon with a hot and wet summer and a cool and usually dry winter. The temperature ranges from a minimum of 7 °C (December to early February) to a maximum of 34 °C (June to August) (extreme range: <5° to >36 °C). The annual rainfall ranges from 2,000 to 4,000 mm, about 75% of which falls in the monsoon (May to September). Winter rains are not uncommon.

Methods

Turtles and tortoises were searched for during foot transects along the existing paths and streams in the forests (totalling 61 km), and boat-transect along Ngengpui River and Palak Dil (2.5 km). Transect along roads (by vehicle) covered 1,847 km. Motor vehicle was used to reach

different sites. Specimens displayed outside the tribal huts (usually all trophies are displayed outside) were also located from a moving vehicle. Houses in select villages were randomly searched for any preserved shell or part thereof. All materials were personally examined, identified, photographed and measured as per standard procedure.

Results

Elongated tortoise *Indotestudo elongata* (Blyth 1853)

Seven preserved specimens were found and examined; two more were reported. The specimens were at Dampa Rengpui and Teirei villages on the outskirts of Dampa Tiger Reserve, Mampui village, Ngengpui-Khawmawi villages, Phura village and Sangau village. Two specimens were reported from Saiha town, but could not be examined. The measurements are given at Table 1.

In areas closer to Mizoram, it has been recorded in Chittagong Hill Tracts of Bangladesh (Das 1995) and Hailakandi district of southern Assam (A. Choudhury, unpubl.). According to the collectors, it is widely distributed in bamboo forest and often caught in *jhummed* areas (after burning of vegetation). The sites of capture ranged from 150 to 1,000 m above msl (at Mampui).

Brown hill or Asian brown tortoise *Manouria emys* (Schlegel & Müller 1840)

Two preserved specimens were seen and examined, and one more reported. The specimens were at Phura and Sangau villages. One reported from Phura could not be examined. The Phura specimen was obtained around 1997 from the hill slope near Palak Dil. The Sangau specimen was obtained in the 1980s from the slopes near the Kolodyne River. The measurements are given in Table 2.

In areas closer to Mizoram, it has been recorded in Rangkhyang Reserve Forest of Bandarban in Chittagong Hill Tracts of Bangladesh (Das 1995) and Hailakandi district of southern Assam (Choudhury 1996b). According to the collectors, it is rare nowadays, as sheer size makes it a prized catch and also easy to spot in *jhummed* areas (after burning of vegetation). The sites of capture ranged from 150 to 500 m above msl (slopes near Sangau). (Regarding subspecies, see discussion).

Unidentified softshell turtles Trionychidae

One preserved carapace seen at Thaltlang village. It was reportedly caught in Kolodyne River. At Palak Dil, more than one species of softshell, including large specimens, have been reported. Regularly caught by villagers at this large lake.

Table 1
MEASUREMENTS OF ELONGATED TORTOISE *INDOTESTUDO ELONGATA* (IN CM)

Specimen/Site	SCL	CCL	SCW (gt)	CCW (n-n)	PL	PL	PW	Remarks
1. Dampa Rengpui	29.0	36.0	18.0	27.0				Nuchal small
2. Teirei	16.5	19.5	12.5	18.5	16.5	14.5	10.5	Nuchal present
3. Mampui	27.5	32.5	18.0	27.5	24.0	20.5	16.5	Nuchal prominent
4. Ngengpui	29.2	34.0	19.2	29.5				Nuchal small
5. Khawmawi	26.5	31.0	17.0	26.0				Nuchal absent
6. Phura	27.0	31.2	18.5	27.0				Nuchal absent
7. Phura	25.7	29.0	16.7	27.0	22.0	19.5	15.5	Nuchal absent. SH = 10.7
8. Saiha								Not examined
9. Saiha								Not examined

TABLE 2
MEASUREMENTS OF BROWN HILL TORTOISE *MANOURIA EMYS* (IN CM)

Specimen/Site	SCL	CCL	SCW	CCW (gt)	PL (n-n)	PL	PW	Remarks
01. Phura	54.0	59.0	36.5	59.0	53.0	49.0	36.0	SH= *c.* 23.0
02. Phura								Not examined
03. Sangau	38.5	44.0	27.5	43.0				CH= *c.* 13.5

In areas near Mizoram, there are records of the Indian softshell turtle *Aspideretes gangeticus* from the Barak river system, southern Assam, where it is among the common turtles locally caught and sold in the market. The major rivers of Mizoram such as the Tlawng (Dhaleswari) and Tuirial (Sonai) are tributaries of the Barak River. Other softshells recorded by me in southern Assam are the Indian peacock softshell *A. hurum* and Indian flapshell turtle *Lissemys punctata*.

Asian leaf turtle *Cyclemys oldhamii* Gray 1863

One preserved carapace examined at Ngengpui-Khawmawi villages. The measurements are given in Table 3.

Near Mizoram, it has been recorded in Chunoti, district Chittagong, Bangladesh and North Cachar Hills district of southern Assam (Das 1995). The sites of capture ranged from 150 to 300 m. The Indian population of *Cyclemys* are now referred to as *C. oldhamii* (Fritz *et al.* 1997).

Indian roofed turtle *Kachuga tecta* (Gray 1831)

No specimen found, but a Forest Department document states 13 individuals counted during the wildlife census on April 31, 1993 in Ngengpui Wildlife Sanctuary.

TABLE 3
MEASUREMENTS OF ASIAN LEAF TURTLE *CYCLEMYS OLDHAMII* (IN CM)

Specimen/Site	SCL	CCL	SCW	CCW
01. Khawmawi	22.0	24.7	16.0	22.0

Indian tent turtle *Kachuga tentoria* (Gray 1834)

Two preserved carapaces were seen at the Office of the Field Director, Dampa Tiger Reserve at West Phaileng. However, both the specimens were obtained from a truck which was carrying, among other things, a large number of turtle shells from Tripura to Champhai town, eastern Mizoram, for onward supply (to smuggle!) to Myanmar.

Keeled box turtle *Pyxidea mouhotii* (Gray 1862)

Three preserved specimens were seen, of which two were examined. These were at Teirei village, on the outskirts of Dampa Tiger Reserve, Dapchua village and at Sangau village. The Sangau specimen was obtained in the 1980s from the slopes near Kolodyne River (For measurements see Table 4).

A specimen was obtained in Hailakandi district, Assam, not far from the Assam-Mizoram border (Choudhury 1998). It has also been recorded in Manipur (Choudhury 1996d). The sites of capture ranged from 150 to 500 m (slopes near Sangau).

CONSERVATION

Problems

Habitat destruction: Habitat destruction by man due to *jhum* cultivation, expansion of agriculture in the valleys, clearance for settlement, encroachment of various kinds, felling of trees, poisoning and dynamiting the rivers for fish, are major threats to the habitat.

TABLE 4
MEASUREMENTS OF KEELED BOX TURTLE *PYXIDEA MOUHOTII* (IN CM)

Specimen/Site	SCL	CCL	SCW	CCW	PL (gt)	PL (n-n)	PW	SH	Remarks
01. Teirei	16.7	19.0	12.0	18.0	16.2	15.7	10.2	-	-
02. Dapchua									Not measured
03. Sangau	17.0	19.0	12.0	17.0	15.7	-	9.5	5.7	-

Poaching: Poaching of turtles is done mainly for the pot. But it is apparent that they are also smuggled out to Myanmar for China and the Far East, for use in traditional Chinese medicine. The past record of trans-shipment of shells from Tripura to Myanmar through Mizoram strengthens this possibility. Fortunately, due to insurgency by the Reang (or Bru) tribals in the north, the movement of civilian vehicles between Damchara in Tripura and Mizoram has almost ceased. All the tribes inhabiting Mizoram, namely Mizo, Lai (Pawi), Mara (Lakher), Chakma, Reang, and Hmar relish turtle meat and any specimen seen is caught for food. In Palak Dil and other lakes, turtles are fished by rod and line, while some Myanmarese come occasionally to the former lake to spear softshells. The villagers of Phura reported that the Myanmarese are expert at spearing turtles, and the local villagers do not protest as the catch is shared.

Other problems: Every year, after burning the hill slopes for *jhum* (February-April), an unspecified number of turtles and tortoises are found either burnt or partly burnt. Some become easy target due to lack of cover. Larger species such as *Manouria emys* take shelter in small hill streams when the surrounding hillsides are burnt.

The ultimate cause of habitat destruction is, however, the very rapid growth of human population. In Mizoram, it grew from 0.33 million in 1971 to 0.69 million in 1991, i.e., more than double in two decades! Since the majority of the rural population practices *jhum* as the main occupation, the large-scale destruction of natural habitat seems inevitable.

Conservation measures taken

Legal Protection: *Aspideretes gangeticus*, *A. hurum* and *Lissemys punctata* are accorded the highest protection under Schedule I of the Wild Life (Protection) Act, 1972, while *Indotestudo elongata* and *Manouria emys* are protected under Schedule IV of the same Act. Most of the villagers are, however, unaware of this legal status. It is difficult to enforce the Act due to lack of information and ignorance.

Habitat Protection: Some of the habitats are under protected areas. However, they account for a meagre *c.* 4.8% of the total area of the State.

Of the six notified protected areas in Mizoram, three may not have sizeable chelonian populations due to their high elevation.

DISCUSSION

The chelonians of Mizoram are poorly known. This report provides some baseline data. It seems that *Indotestudo elongata* is still fairly common and widespread. *Manouria emys*, which has become extremely rare in the north and central Mizoram is still found in the south where some good forest remains. All the species are reported for the first time from Mizoram.

Variation in nuchal among *Indotestudo elongata* is interesting. It is absent in three specimens and prominent in one. I have observed specimens in Dhubri and Bongaigaon districts of Assam, in which the nuchal was absent or very insignificant.

The specimen of *Manouria emys* examined at Phura resembled the subspecies *emys* in having

large gulars that extend well beyond the carapace rim and also being relatively small in size. But interestingly, its pectorals do not resemble either of the subspecies. The scutes narrow towards the point. It resembles to some extent the Rangkhyang specimen (however, the scutes of pectorals narrow towards the contact point, but scarcely touch each other, Das 1995) as well as a specimen at Guwahati Zoo from northern Karbi Anglong (Choudhury 1996b,c). These are considered to be *emys-phayrei* intergrade (Das 1995). However, Anderson (in Das 1991) believed that both subspecies were inseparable. Anderson's specimens from Naga Hills (Nagaland), the specimen at Guwahati Zoo from Karbi Anglong and the ones from Rangkhyang and Mizoram seemed to possess characteristics of both the subspecies. Bhupathy (1994) suggested a re-evaluation of its taxonomic status.

Poaching for meat, habitat destruction through *jhum*, and the trade across the international boundary seem to be the major threats. Even in protected areas, the chelonians are not completely secure due to the ignorance of the human population. The fringe villagers know that killing of elephant *Elephas maximus* or tiger *Panthera tigris* is prohibited, but are not so aware regarding chelonians.

RECOMMENDED CONSERVATION MEASURES

1. **Creation of new Protected Areas**: Some important habitats such as Palak Dil should be brought under the protected area network.
2. **Extension of existing protected areas**: Part of Ngengpui Reserve Forest should be added to the Ngengpui Wildlife Sanctuary.
3. **Check on poaching and trade**: Poaching of chelonians should be checked at this stage, at least in the protected areas. The anti-poaching staff should be motivated and made aware that besides the mega species such as elephant and tiger, chelonians also need their attention. Awareness among villagers with the help of NGOs will also be useful.
   However, the most serious is the reported trade in preserved shells across the international boundary for use in traditional Chinese medicine, which encourages poachers to deliberately search for chelonians. This needs to be monitored and checked, at least on the main trade routes such as Champhai.
4. **Check on *jhum***: While it is impossible to stop this practice, it can be reduced by introducing terracing, cash crops and horticulture.
5. **Other measures**: More detailed survey of the villages and the forest for further information on chelonians. Conservation education among locals, including the hill tribes of remote areas. Last, but not least, is the need to take up massive population control measures for the humans in the fringe areas. Considering the high literacy in the state, any awareness campaign should be smooth in comparison to other northeastern states.

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DISTRIBUTION AND DEMOGRAPHY OF DIURNAL PRIMATES IN SILENT VALLEY NATIONAL PARK AND ADJACENT AREAS, KERALA, INDIA[1]

K.K. Ramachandran and Gigi K. Joseph[2]

Key words: Distribution, demography, *Macaca silenus*, *Trachypithecus johnii*, *Macaca radiata*, *Semnopithecus entellus*

Distribution and demography of all diurnal primates were studied in Silent Valley National Park and adjacent areas for a period of three years from 1993 to 1996. Fourteen troops of lion-tailed macaque, eighty-five troops of Nilgiri langur, fifteen troops of bonnet macaque and seven troops of Hanuman langur were observed. Of these, the Nilgiri langur was randomly distributed, whereas the lion-tailed macaque troops were confined to the southern sector of the Park. Bonnet macaques and Hanuman langurs were occasional visitors, especially during summer and northeast monsoon in the southwestern fringes of the National Park. Demographical studies revealed that the Silent Valley forest remains one of the most undisturbed viable habitats left for the endemic and endangered primates of the Western Ghats like the lion-tailed macaque and Nilgiri langur.

Introduction

India is well known for its rich primate fauna with as many as 15 species. These include seven macaque, five langur, two loris, and one ape species (Agrawal, 1998). The highest number of primate species in India is seen in the northeastern states, where 10 species occur in sympatry (Molur *et al.* 1998). The distribution of these primates very often extends to the Southeast Asian countries like Bangladesh, Myanmar, Indonesia, Thailand and South China. But the two endemic primates of the Western Ghats, namely lion-tailed macaque (*Macaca silenus*) and Nilgiri langur (*Trachypithecus johnii*), exist in the wild only in the south Indian states of Kerala, Karnataka and Tamil Nadu. Slender loris (*Loris tardigradus*), Hanuman langur (*Semnopithecus entellus*) and bonnet macaque (*Macaca radiata*) are also distributed in the state of Kerala.

In the last two centuries, up to 1970, extensive forest destruction for plantations and agriculture, and poaching severely affected the primate population in the Kerala part of the Western Ghats. However, the inclusion of vast stretches of forests in the protected area network, and the implementation of the Wildlife (Protection) Act in 1972, has helped to restore populations to some extent in many areas. Silent Valley National Park is still among the least disturbed evergreen forests in the country and it is important to estimate and monitor the primate populations there.

A number of studies have mentioned the status and distribution of primates in Silent Valley forests (Daniel and Kannan 1967, Kurup, 1975 1978, Roonwal and Mohnot 1977, Green and Minkowski 1977, Ali 1985, Easa *et al.* 1997). But it was Vijayan and Balakrishnan (1977) who first studied the mammalia exclusively in the rainforest ecosystem of the Silent Valley, in connection with a study on the impact of the hydroelectric project on wildlife. Later, Balakrishnan (1984) documented the need for conserving these rainforests, as it formed an important habitat of many larger mammals. Though some recent studies (Ramachandran 1990, Joseph 1998, Joseph and Ramachandran 1998) have described the distribution, status and

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demography of lion-tailed macaque, no detailed work was done on other primates, especially after the declaration of the National Park in 1984. The present paper deals with the distribution and demography of all diurnal primates in Silent Valley National Park and adjacent areas.

Study area

The Silent Valley National Park is situated in Palghat district, Kerala (11° 3' to 11° 13' N and 76° 21' to 76° 35' E). It is one of the core areas of the Nilgiri Biosphere Reserve. The National Park extends over 90 sq. km and has pure evergreen vegetation. Kunthipuzha, a tributary of Bharathapuzha, originating from the northeastern hill ranges of the National Park, drains the area. The altitude varies between 658 to 2,383 m. Silent Valley forests receive some of the highest rainfall in the entire Western Ghats, with an average of 6,000 mm per year. The annual mean temperature is *c.* 20 °C.

The highly diverse flora of Silent Valley consists of 966 species belonging to 134 families and 559 genera (Manilal 1988). This comprises 701 dicotyledons and 265 monocotyledons. The five dominant families recorded are: Orchidaceae, Poaceae, Fabaceae, Rubiaceae and Asteraceae. Relative abundance of certain species in specific patches has resulted in the formation of certain tree associations. Six distinct tree associations can be distinguished in the Valley, and they are:- i) *Cullenia exarillata-Palaquium ellipticum*, ii) *Palaquium ellipticum-Mesua ferrea*, iii) *Mesua ferrea-Calophyllum elatum*, iv) *Palaquium ellipticum-Poeciloneuron indicum*, v) *Calophyllum elatum-Ochlandra* sp. vi) *Poeciloneuron indicum-Ochlandra* sp. Among these, the first three tree associations are restricted in the southern sector, whereas the rest of them are confined to the central and northern parts of the National Park (Aiyar 1932).

Methods

Distribution and demography of primates were studied in the National Park and adjacent areas for three years from 1993 to 1996, as part of the endangered primate research project. The National Park and the adjacent areas, were stratified into 12 major blocks of average 10 sq. km area. As the troops of each primate species were not randomly distributed in the highly undulating terrain, line transect method of estimating the animal population (Burnham *et al.*, 1980) was found unsuitable. So total count and sweep sampling methods were used (NRC 1981, Whitesides *et al.* 1988). Repeated surveys were conducted on foot in each of the blocks to count troop size, structure and sex ratio. Individuals of each species were classified into five categories based on the morphological differences as recorded in literature (Poirier 1969, Roonwal and Mohnot 1977, Kumar 1987, Joseph 1998).

Results

Lion-tailed macaque (*Macaca silenus*)

Fourteen troops of lion-tailed macaque were identified from Silent Valley National Park and adjacent areas (Table 1). The troops tended to be distributed towards the southern side of the Park, in specific tree association areas such as *Cullenia-Palaquium*, *Palaquium-Mesua* and *Mesua-Calophyllum* prevailing in the evergreen habitat. They were seen in Sairandri, Puchappara and Nilikkal sections within the Park and Panthenthod section of the Attappady reserve forests. A preference for altitudes between 700 and 1,500 m was observed. A total of 275 individuals were observed with an average troop size of 19.64 individuals. The troop size varied from 9 to 36 individuals. The population consisted of more adults (53%) than immatures (47%). The adult sex ratio (1:5.63) was strongly in favour of females (Table 2).

TABLE 1
POPULATION STRUCTURE OF PRIMATE COMMUNITY IN SILENT VALLEY NATIONAL PARK AND ADJACENT AREAS

Species	Number of troop sightings	Total individuals sighted	Number of troops estimated	Estimated population size	Average troop size	Troop size range
LTM	1,793	6,398	14	275	19.64	9-36
NL	1,410	5,418	85	501	5.89	1-14
BM	66	531	15	192	12.8	5-30
HL	25	63	7	24	3.4	1-6

LTM = Lion-tailed macaque, NL = Nilgiri langur, BM = Bonnet macaque, HL = Hanuman langur

Nilgiri langur (*Trachypithecus johnii*)

Unlike the lion-tailed macaque, the Nilgiri langur had a wide range of distribution from 400 to 2,300 m elevation in and around the Silent Valley National Park. Though there is variation in the tree associations of different locations, the distribution of this arboreal species was observed in all tree associations of the Park A total of 5,418 individuals, from 1,410 troop records were observed (Table 1). Eighty-five troops were identified from the overall troop sightings. A total of 501 individuals were observed with an average troop size of 5.89 individuals. Of these, 20.16% were adult males and 40.12% were adult females. The gender of 5.19% of the adults could not be determined, and the rest of the population constituted immature langurs. The adult male-female ratio estimated was1:1.99.

Bonnet macaque (*Macaca radiata*)

Most of the bonnet macaque sightings were concentrated in the southern fringes of moist deciduous forests bordering the National Park. However, they were observed in the evergreen areas inside the Park during the summer and northeast monsoon. Bonnets were sighted in Sairandri, Aruvampara, Punnamala, Parathod, Panthenthod, Chembotty, Nilikkal, and Walakkad areas. A total of fifteen troops were identified, having 192 individuals altogether (Table 1). The average troop size was 12.8 individuals, varying from five to thirty individuals. Percentage composition of adult males was 11.45% and of the adult females 31.25%. The adult male-female ratio was 1:2.72 (Table 2).

Hanuman langur (*Semnopithecus entellus*)

Hanuman langur troops were commonly seen in the moist deciduous forests of Mannarghat Forest Division bordering the southern region of the National Park. Many a time, they were seen foraging solitarily or along with Nilgiri langurs in the evergreen areas,

TABLE 2
AGE-SEX COMPOSITION OF PRIMATES IN SILENT VALLEY

Species	Adult male	Adult female	Unidentified adult	Immature	Adult male-female ratio
LTM	22	124	-	129	1:5.63
NL	101	201	26	173	1:1.99
BM	22	60	52	58	1:2.72
HL	5	9	1	9	1:1.8

LTM = Lion-tailed macaque, NL = Nilgiri langur, BM = Bonnet macaque, HL = Hanuman langur

especially in October and November. Their occasional visit to the evergreen forests was found to be limited to the peripheral regions of *Cullenia-Palaquium* tree association patches, notably in the Nilikkal area. Once a solitary Hanuman langur was sighted in the Aruvampara region east of Kunthipuzha river. Out of the total sightings, seven troops were identified having 24 individuals (Table 1). Average troop size estimated was 3.4 individuals. Among the total individuals observed 20.8% were adult males and 37.5% were adult females (Table 2). The percent composition of immature was 37.4%, while the gender of 4.1% of the adults could not be determined.

Discussion

The study reveals the existence of a healthy population of lion-tailed macaque and Nilgiri langur thriving in the Silent Valley National Park and adjacent areas. The extensive habitat continuity of the evergreen forests with least human interference help to establish an interbreeding primate population. Most of the lion-tailed macaque troops in the Western Ghats exist as small populations due to extensive fragmentation of the rainforest habitat. These small populations often undergo random shifts in size naturally or due to human influence. Such events can cause a dramatic shift, and can be destructive to the population, even leading to local extinction. Out of the total population of lion-tailed macaque, the Kerala part of Western Ghats hoids more than 50% and the rest is shared between Karnataka and Tamil Nadu (Kumar *et al.*, 1995). The Silent Valley population having 14 troops with 275 individuals remains one of the most important populations in its entire range. Modelling and simulation exercises were done using the same data, and it was found that the population is viable, facing no serious threats in the next 100 years (Lacy *et al.* 1996).

Though a healthy viable population of lion-tailed macaque is present in the study area, its distribution is more common in the *Cullenia-Palaquium* tree association areas, which provides ample food supply throughout the year. The *Poeciloneuron-Ochlandra* association patches in the higher elevations lack many of the food species of the highly arboreal lion-tailed macaque. This may be the reason for its absence in the upper reaches of Silent Valley National Park. Though the major ecological niche of the Nilgiri langur is the high altitude (1,600-1,900 m) montane shola, they have survived well in the low altitude (400-800 m) evergreen, semi evergreen and even moist deciduous habitats adjacent to the National Park. This is the most common folivorous primate distributed throughout the Park, irrespective of the various tree associations.

The primate community in Silent Valley constitutes four diurnal species, of which the bonnet macaque and Hanuman langur are not very common inside the Park. Bonnets are occasional visitors, preferring the summer and post monsoon, as there is higher availability of food in the evergreen areas during these seasons. The summer months have abundant *Syzygium* fruits, while in the monsoon, there is cauliflorous flowering of *Cullenia exarillata,* which was observed to be a favourite food item for all the four primates and the Malabar giant squirrel, *Ratufa indica*. Hanuman langur troops were common in the Mannarkad Reserve Forest bordering the western region of the Park, their range extends from the lower altitude moist deciduous areas to the comparatively high altitude evergreen areas. During the *Cullenia* flowering season, Hanuman langur has been reported from the Park for the first time. Many a time, Nilgiri langurs were sighted along with the Hanuman langur troops in moist deciduous areas. There is, therefore, a need for genetic studies to verify whether both interbreed in the southwestern region of the National Park.

Attappady Reserve Forest (RF), located adjacent to the National Park, has low lying evergreen forests with great conservation value. The present study reveals a population of lion-tailed macaque, Nilgiri langur and bonnet macaque thriving especially in the Panthenthod areas which is part of the Attappady RF. This area suffers more human interference than other areas inside the National Park. Trapping of nine lion-tailed macaque individuals from a troop inhabiting these areas by Muduga tribals during the study period itself is a clear instance of poaching. The whole area of Silent Valley National Park is treated as 'core zone'. There is a need for demarcating a buffer zone for the Park, which should also include the floristically and faunistically rich Attappady RF, particularly the Panthenthod area.

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FISHES OF THE SUBFAMILY NEMACHEILINAE REGAN (CYPRINIFORMES : BALITORIDAE) FROM MANIPUR[1]

W. Vishwanath and Juliana Laisram[2]

(*With four text-figures and three plates*)

Key words: Fish, Nemacheilinae, Manipur.

Subfamily Nemacheilinae of Manipur State, India, is represented by 12 species, belonging to 3 genera, namely *Acanthocobitis* Peters and *Neonoemacheilus* Zhu & Guo with 2 species each and *Schistura* McClelland with 8 species. Diagnostic characters of the species, colour patterns, updated geographical distribution, detailed morphometric data, and illustrations are given based on fresh specimens collected from the State. *N. assamensis* (Menon) and *S. nagaensis* (Menon) are treated as valid species here. Distribution map and key to identification of species are also provided.

Introduction

Fishes of the Subfamily Nemacheilinae Regan (Cypriniformes: Balitoridae) are small sized loaches inhabiting benthic zones of fresh, well aerated hill stream waters of Asia, Ethiopia and Europe. The group is characterised by an elongate, rounded body, a subterminal mouth, presence of prepalatine, 3 pairs of barbels: 2 rostral and 1 maxillary, 1 simple ray each in pectoral and pelvic fins, and absence of spine under or before eye (Nelson 1994). Menon (1987) recognized 2 genera, namely *Triplophysa* and *Noemacheilus* under this subfamily. However, Kottelat (1990) while revising the nemacheilines of Southeast Asia, recognised as many as 31 genera.

Manipur, with its numerous hill streams, is rich in loach fauna. The western side of the State is drained by the Barak and its tributaries, which form the Brahmaputra basin. The central plain is drained by the Imphal River and its tributaries, which finally form the Manipur River, which then flows out of the State to join the Chindwin in Myanmar. The river Tizu and its tributaries, and the Chatrickong drain the northern and central part of Ukhrul district respectively, and then enter Myanmar to join the Chindwin. The Maklang and Namya Rivers draining the southern part of Ukhrul district, the Lokchao draining the Chandel district and several other streams draining the eastern part of the State join the Yu River, a tributary of the Chindwin in Myanmar. Chaudhuri (1912) described *Nemacheilus* (now *Schistura*) *manipurensis* from Ukhrul district. Hora (1921) described *N. kanjupkhulensis*, *N. prashadi* and *N. sikmaiensis* (all currently in the genus *Schistura*), while reporting on the fish and fisheries of Manipur. His report from the state also included *N. botia* (now *Acanthocobitis*), but the place of collection was Ghaspani, Nagaland. Subsequent reports on the fishes of the state by Hora (1936), Menon (1953) and Menon (1954) did not add any more nemacheilines to the list.

Menon's (1987) revision of family Homalopteridae (now Balitoridae) also reported *Noemacheilus peguensis* (now *Neonoemacheilus*) and *N. vinciguerra* (now *Schistura*) from the state.

Most of the data presented by previous workers on this group of fishes of Manipur suffers from certain drawbacks: (1) they did not have fresh specimens for examination. Many specimens were in bad shape (e.g. *Neonoemacheilus peguensis*). Types of *Schistura sikmaiensis*, in ZSI have been lost, and a neotype from Myitkyina, Myanmar had to be designated (Kottelat, 1990). Moreover, in these specimens, some characteristic colour patterns are lost due

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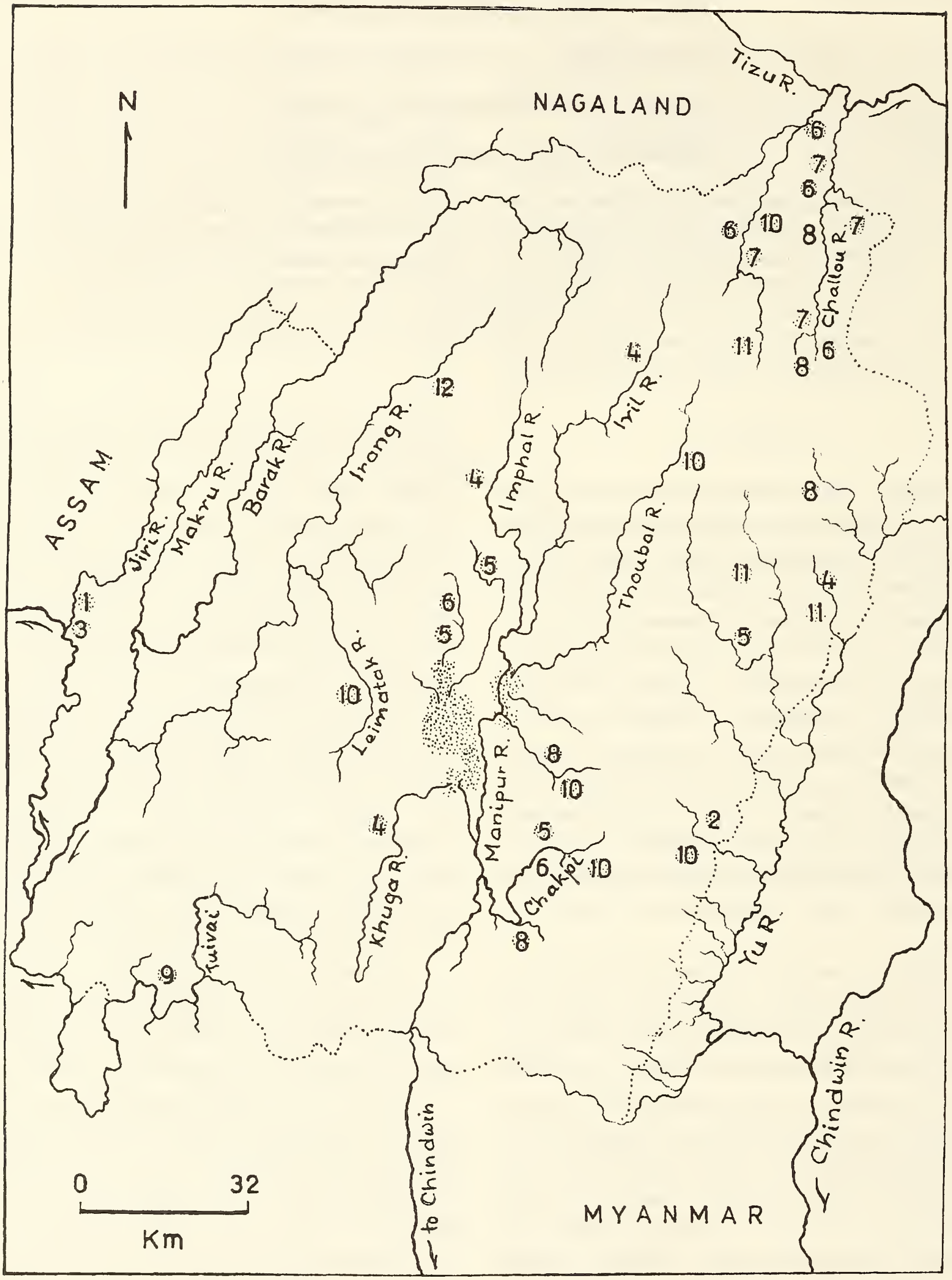


1. *Acanthocobitis botia*, 2. *A. zonalternans*. 3. *Neonoemacheilus assamensis*, 4. *N. peguensis*, 5. *Schistura kanjupkhulensis*, 6. *S. manipurensis*, 7. *S. nagaensis*, 8. *S. prashadi*, 9. *S. scaturgina*, 10. *S. sikmaiensis*, 11. *S. vinciguerra* and 12. *Schistura* sp.

Fig. 1: Map of Manipur showing distribution of nemacheiline fishes

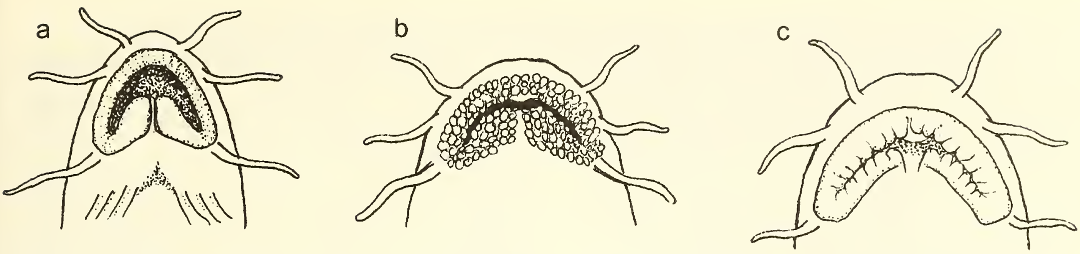


Fig. 2: Mouth and lips of nemacheiline genera: a. *Neonoemacheilus*, b. *Acanthocobitis* and c. *Schistura*.

to long preservation. (2) The descriptions were based on 1-4 specimens. e.g., 1 for *N. peguensis*, 2 each for *S. kanjupkhulensis* and *S. prashadi*, 3 for *S. sikmaiensis* etc. (3) Type localities are not clearly stated, leading to confusion in the distribution in different drainage basins. (4) The morphometric data is inadequate. (5) There is no proper illustration for some species *(N. assamensis*, *N. nagaensis*).

In the present work, 164 specimens in MUMF (Manipur University Museum of Fishes, Manipur University) and a few in ZSI (Zoological Survey of India, Kolkata), collected from Manipur and its adjoining areas were examined. Morphometric measurement followed Kottelat (1990). The collections include 3 genera, namely *Acanthocobitis* Peters and *Neonoemacheilus* Zhu & Guo with 2 species each, and *Schistura* McClelland with 8 species. *N. assamensis* (Menon) and *S. nagaensis* (Menon) are treated here as valid species. *A. botia* (Hamilton) is reported from the state. Systematic accounts are presented; a key to the species and a distribution map (Fig. 1) have also been provided.

Abbreviations used: MUMF= Manipur University Museum of Fishes; ZSI = Zoological Survey of India; WV = W. Vishwanath, WM = W. Manojkumar, HL = H. Lilabati, LK = L. Kosygin, KS = K. Selim, WJ = W. Jayadev, KN = K. Nebeshwor, SB = S. Bijoy, Unreg. = Unregistered, R = River, Str. = Stream. Under head 'Material examined' of every species, the MUMF registration number, followed by number of specimens examined, standard length of fish, site and date of collection are given.

Systematic Account

Key to the Genera of Nemacheilinae Regan in Manipur

1a. Mouth hypertrophied, lips forming a preoral cavity; lower lip in the form of two thick pads, interrupted in the middle (Fig. 2a) .... *Neonoemacheilus*

1b. Mouth not hypertrophied, lower lip not in the form of two thick pads (Fig. 2b & 2c) 2

2a. A conspicuous black spot at the upper extremity of caudal base, no transverse black bar at the base of caudal fin (Fig. 3a) .... *Acanthocobitis*

2b. No black spot at upper extremity of caudal base, a black transverse bar at the base of caudal fin (Fig. 3b) .... *Schistura*

Acanthocobitis Peters

Acanthocobitis Peters, 1861: 712 (type species: *A. longipinnis* Peters). Kottelat, 1990 (revision). Banarescu & Nalbant, 1995: 432 (generic classification)

Diagnosis: Nemacheiline genus, recognised by a comparatively deep body which is compressed posteriorly; compressed head, nostrils close together, the anterior one without a barbel-like prolongation; large imbricate scales

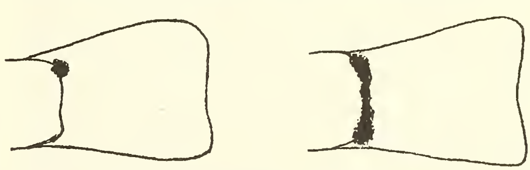


Fig. 3: Coloration on caudal base:
a. *Acanthocobitis* and b. *Schistura*.

with small focus; scales absent on head and reduced on chest; upper lip usually with papillated pad, with a broad median interruption; dark transverse bands or irregular markings or regularly arranged spots on body; a conspicuous black spot at upper extremity of caudal base, lateral line complete or incomplete; males with a suborbital flap or a suborbital groove.

The counts are as: D. iv, 9½-12½, A. ii-iii, 5½, C. /9+8/ P. 11-13, V. 7-8.

Key to species:

1a. Lateral line complete; branched dorsal rays 12½ .... *A. botia*

1b. Lateral line extends up to middle of dorsal fin; branched dorsal rays 9½-10½.. *A. zonalternans*

Acanthocobitis botia (Hamilton)
(Plate 1, Fig a)

Cobitis botia Hamilton, 1822: 350 (type locality: Ganges)

Acanthocobitis botia: Kottelat, 1990 (revision)

Material examined: MUMF, 6, 43.4-62.8 mm, Jiri R., LK and SB, January, 1998. MUMF 3015, 1, 62.8 mm, KN. 5.v.1999

Diagnosis: In addition to the key characters, other diagnostic characters are: dorsal profile slightly convex anteriorly and concave posteriorly, pectoral fin extends to more than half of the distance between pectoral and pelvic fin origins. Pelvic fin origin under 3rd-4th branched dorsal fin ray. Dorsal fin inserted slightly ahead of middle of body. Head rounded, eyes on dorsal half of head. Body covered with scales. Lateral line complete. Caudal fin slightly emarginate.

Colour: A distinct, thin, dark line above lateral line; 8-10 elongate vertical blotches on body, shapes variable. 10-11 black patches ('saddles' as mentioned by Kottelat, 1999) on back, extending towards lateral line alternate with the blotches. Dorsal fin with 5-6 horizontal series of black spots, caudal fin with 7-8 vertical series, V-shaped, pointed posteriorly.

Distribution: River Indus, Pakistan to Mae Khlong of Thailand, through Ganga, Brahmaputra, Chindwin, Irrawady, Sitang and Salween basins.

Remarks: Morphometric data given in Table 1. The species is represented only in the collections from Barak and its tributaries (Brahmaputra basin) and not from the Chindwin basin of the State. Hora (1921) included the species in the list of fishes collected from Manipur. However, collection site was Ghaspani, a village in Nagaland, in the Brahmaputra basin.

Acanthocobitis zonalternans (Blyth)
(Plate 1, Fig. b)

Cobitis zonalternans Blyth, 1860: 172 (type locality: Tenasserim Province, Myanmar)

Acanthocobitis zonalternans: Kottelat, 1990: 35, figs. 11a, 17, 18 (revision); Banarescu & Nalbant, 1995: 433 (general classification and diagnostic characters).

Material examined: MUMF 3016, 6, 38.6-44.9 mm, Lokchao river, Moreh, WV & party, 25.iii.1999.

Local name: Ngatup

Diagnosis: In addition to key characters, diagnostic characters are: pectoral fin extends to almost 2/3rd the distance between pectoral and pelvic fin origins. Pelvic fin originates behind 4th-5th branched dorsal fin ray. Dorsal fin origin slightly ahead of middle of body. Body and belly with embedded scales. Lateral line incomplete, reaching middle of dorsal fin base. Caudal fin emarginate.

Colour: Body light brown with 12-13 vertical bars of variable shape, extending from back to middle of body. Dorsal black patches 10-13, extending to lateral line, alternating with vertical bars. Bars and patches thinner anteriorly.

Distribution: INDIA: Chindwin basin in Manipur to Mae Khlong and Tapi basins of Thailand, through Sitang and Salween basins.

TABLE 1
MORPHOMETRY OF *A. BOTIA* AND *A. ZONALTERNANS* (IN % OF SL EXCEPT SL, IN MM)

	A. botia (N=7)			*A. zonalternans* (N=6)		
	Mean	Range	S.D.	Mean	Range	S.D.
Standard Length		43.4-82.8			38.6-44.9	
Depth of Body	20.9	18.0-24.4	1.9	19.8	17.9-22.0	1.3
Lateral Headlength	24.5	22.8-25.3	0.9	24.2	23.2-25.6	0.9
Dorsal headlength	21.9	20.8-23.0	0.8	21.6	20.9-22.7	0.6
Head depth (at nape)	15.0	14.1-15.8	0.5	15.5	14.2-17.3	0.9
Head depth (at eye)	12.6	11.7-13.4	0.6	12.7	12.2-13.9	0.6
Snout length	9.7	9.0-10.9	0.6	9.1	8.1-10.2	0.7
Eye Diameter	5.8	5.3-6.0	0.2	5.1	4.4-5.8	0.5
Interorbital width	6.5	5.9-7.2	0.5	7.7	6.7-8.5	0.6
Maximum head width	15.3	14.5-16.6	0.6	14.8	13.5-15.3	0.7
Head width (at nares)	9.5	8.6-11.2	0.9	9.6	9.0-10.1	0.3
Mouth gape width	6.0	4.8-7.4	0.8	5.9	5.1-6.4	0.4
Internarial width	5.6	5.1-6.0	0.4	5.7	4.7-7.1	0.8
Length of caudal ped.	13.0	11.5-14.4	0.9	13.5	11.4-16.4	1.6
Height of caudal ped.	12.8	12.2-13.4	0.4	12.9	12.0-14.4	0.8
Body width (dorsal origin)	14.5	13.1-16.1	0.9	13.4	11.9-14.0	0.7
Body width (anal origin)	9.3	8.3-10.2	0.6	9.6	8.5-10.8	0.8
Height dorsal fin base	21.2	19.5-23.3	1.5	20.0	19.0-20.8	0.8
Height of dorsal fin	21.0	16.9-24.1	2.2	22.2	21.1-23.6	1.0
Length of pectoral fin	20.8	19.5-22.1	1.0	22.4	21.0-24.4	1.2
Length of ventral fin	16.5	15.3-17.4	0.7	18.6	16.8-20.5	1.5
Length of anal fin	8.1	7.5-8.8	0.6	8.7	7.6-10.2	0.9
Length of upper caudal lobe	23.8	22.4-25.2	1.0	25.9	24.4-28.2	1.2
Length of lower caudal lobe	22.9	21.4-23.9	0.9	25.9	24.4-28.2	1.2
Predorsal length	44.9	42.2-46.8	1.4	47.6	45.1-49.0	1.4
Pre pelvic length	52.9	51.9-54.7	0.9	55.1	53.9-57.4	1.3
Pre anal length	79.4	77.9-80.4	1.0	79.0	77.8-83.1	1.7
Pre anus length	73.9	72.7-75.8	1.0	73.5	71.5-75.7	1.5

Remarks: Morphometric data are given in Table 1. Hora (1921) reported the fish to be plentiful in Manipur Valley. However, now it occurs only in the streams draining into the Yu River (tributary of Chindwin). Kottelat's (1990) inclusion of Brahmaputra in the distribution of the species needs confirmation. None of the material he examined, as listed on pp. 36-38 was from the said basin.

Neonoemacheilus **Zhu & Guo**

Neonoemacheilus Zhu & Guo, 1985: 321 (type species: *Nemacheilus labeosus* Kottelat). Kottelat, 1990 (revision). Banarescu & Nalbant, 1995; 436 (generic classification)

Infundibulatus Menon, 1987: 177 (type species: *Nemacheilus peguensis* Hora, new subgenus of *Nemacheilus* (Bleeker)

Diagnosis: A nemacheiline genus with hypertrophied lips forming a preoral cavity. Lips with transverse ridges, flat, lower lip in the form of two thick pads, interrupted in the middle. Scales imbricate; Lateral line complete. Body with 13-21 dark brown transverse bars; suborbital flap in males. Body slender, dorsal profile arched, ventral more or less straight, compressed moderately before dorsal fin origin, more compressed behind. Head comparatively deep. Mouth ventral, placed behind tip of snout. Lips broad, *processus dentiformes* moderately

developed. Barbels 3 pairs; inner rostral reaches corner of mouth, outer rostral and maxillary slightly longer. Anterior nostril opens obliquely in front side of a flap-like tube. Body covered with scales, absent on ventral surface. Lateral line complete.

The counts are: D. iv, 8½-9½; A. iii, 5½; C. /9+8/; P. 11-12; V. 7-9.

KEY TO SPECIES

1a. Branched dorsal fin rays 8½, head depth 12.9.(11.8-13.7)% of SL; body with 13-17 dark brown transverse bars .... *N. assamensis*

1b. Branched dorsal fin rays 9½; head depth 14.3 (13.4-15.0)% of SL; body with 20-21 dark brown transverse bars .... *N. peguensis*

Neonoemacheilus assamensis (Menon)
(Plate 1, Fig c)

Noemacheilus assamensis Menon, 1987; 179 (type locality: Pagladia River, Assam)

Material examined: MUMF 3011, 11, 35.1-43 mm, Jiri R., tributary of Barak R., Jiribam, WV & party, December, 1997.

Local name: Ngatup

Diagnosis: Species with 8½ branched dorsal fin rays; a conspicuous pad on tip of snout overhanging mouth, width of mouth 53.4-55.6% of head width; head depth 54.1-66.7%, interorbital space 16.3-25.3% of HL; 13-17 dark brown transverse bars on body. Pectoral fin reaches midway to base of pelvic, the latter just reaches anus or a little beyond. Anus situated nearer to anal fin than to origin of pelvic fin. Mouth semicircular, situated a little behind the snout (Fig. 2a). Upper lip thin, moderately hypertrophied, a pad-like structure in the middle. Body covered with scales except head, but more sparsely between pectoral fins. Scales minute, oval-shaped with large focus (Fig. 4a). Lateral line complete with 80-85 pores.

Sexual dimorphism: Males with well developed suborbital flap and breeding tubercles on pectoral fin (Figs 4b, 4c)

Colour: Body creamish-white with 13-17 light brown transverse bars extending from back to 2/3rd of flank, not reaching ventral surface, interspace wider. Width of bar increases with size of fish. A dark bar, fainter in the middle, present on caudal base. All fins hyaline. Snout with 4 transverse stripes. Dark brown triangular spot on occiput, a small dark spot between the nares.

Distribution: INDIA: Pagladia R., Assam, Jiri R., Manipur (both of Brahmaputra basin).

Remarks: Morphometric data given in Table 2. Menon (1987) described the species based on a single specimen. Although he mentioned a paratype, he did not provide an illustration. Kottelat (1990, p. 72) distinguished the species from *N. peguensis* by its smaller number of branched dorsal fin rays and slender caudal peduncle. However, he could not describe the species due to paucity of material. Banarescu & Nalbant (1995) made no mention of the species. In the present study, 11 examples of the fish from Jiri R. of Manipur were examined. The species is redescribed here.

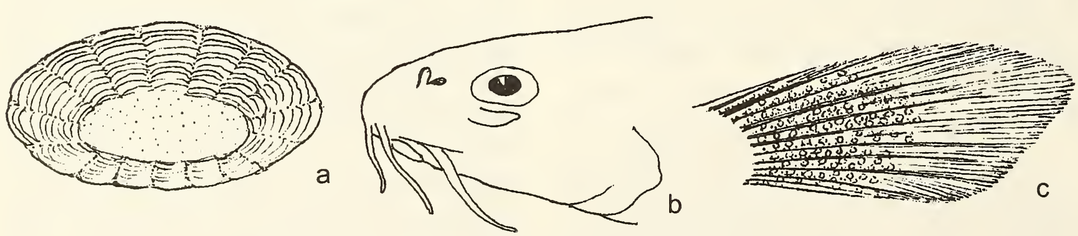


Fig. 4: Different body parts of *Neonoemacheilus assamensis*:
a. Scales from above pectoral fin, b. suborbital flap in males, c. breeding tubercles on pectoral fins of male

Neonoemacheilus peguensis (Hora)
(Plate 1, Fig d)

Nemachilus peguensis Hora, 1929: 320, pl. 14, figs. 1, 2 (type locality: Pegu Yoma)

Neonoemacheilus peguensis: Kottelat, 1990: 75, fig 45 (revision, holotype examined)

Material examined: MUMF 3012, 1, 40.7 mm, Imphal R. WJ, 3.iii.1999; MUMF 3013, 2, 49.9-62.9 mm, Iril R., LK, March, 1999.

Local name: Ngatup

Diagnosis: A species with broad lips, mouth width 66.7-70.7% of head width; branched dorsal fin rays 9½; no pad on ventral surface of snout tip; head deeper 68.6 (67.8-69.1)% of head length; interorbital width 28.5 (24.6-31.0)% of head length; 20-21 dark brown transverse bars on body.

Sexual dimorphism: Males have a well developed suborbital flap.

Colour: Body creamish-white, 20-21 thin transverse dark brown bars extending from back to 2/3rd of flank. Fins with no markings. Occiput with dark dots.

Distribution: INDIA: Iril and Imphal rivers (in Manipur Valley), Namya R., a tributary of Yu river of Myanmar (all of Chindwin basin); Myanmar: Pegu Yoma (Irrawady basin).

Remarks: Morphometric data given in Table 2. The specimens under examination are *N. peguensis* as they agree well with the

TABLE 2
MORPHOMETRY OF *N. ASSAMENSIS* AND *N. PEGUENSIS* (IN % OF SL EXCEPT SL IN MM)

	N. assamensis (N=11)			*N. peguensis* (N=3)		
	Mean	Range	S.D.	Mean	Range	S.D.
Standard Length		35.1-43.8			40.7-62.9	
Depth of Body	17.0	15.5-19.5	1.17	18.2	17.0-20.2	1.4
Lateral headlength	23.7	22.8-24.8	0.58	23.4	22.9-24.1	0.5
Dorsal headlength	20.8	19.2-22.3	0.82	20.9	19.4-21.9	1. 1
Head depth (at nape)	12.9	11.8-13.7	0.65	14.3	13.4-15.0	0.7
Head depth (at eye)	10.2	9.3-10.9	0.46	11.9	11.6-12.4	0.4
Snout length	8.3	7.4-9.0	0.46	10.1	9.4-10.7	0.5
Eye Diameter	5.8	5.4-6.7	0.27	5.0	4.6-5.4	0.3
Interorbital width	4.5	3.6-5.2	0.48	6.0	5.2-6.9	0.7
Maximum head width	12.9	11.8-13.7	0.65	14.0	13.8-14.3	0.2
Head width (at nares)	8.1	7.0-8.9	0.51	8.2	4.8-10.3	1.4
Length of caud. ped.	13.4	12.3-14.6	0.57	13.2	12.8-13.4	0.3
Height of caud. ped.	9.7	9.1-10.3	0.43	11.1	10.3-11.6	0.6
Body width (dorsal origin)	12.1	10.1-13.4	0.88	13.7	12.0-15.1	1.3
Body width (at anal origin)	7.9	6.7-9.3	0.86	8.2	6.8-9.2	1.0
Height dorsal fin base	15.7	13.9-16.9	0.70	17.6	15.8-19.1	1.4
Height of dorsal fin	20.4	19.5-23.0	1.19	19.6	18.0-20.6	1.1
Length of pectoral fin	22.1	21.1-23.0	0.63	19.8	18.1-21.6	1.4
Length of ventral fin	16.8	15.9-17.7	0.66	15.8	14.6-16.7	0.9
Length of anal fin	8.1	6.4-9.7	0.96	8.2	8.0-8.6	0.3
Length of upper caudal lobe	23.9	22.8-26.1	1.06	24.5	24.0-24.8	0.3
Length of lower caudal lobe	25.1	23.9-27.2	0.90	24.3	23.7-25.3	0.7
Predorsal length	44.7	43.6-50.4	1.90	50.0	49.1-50.5	0.7
Pre pelvic length	52.5	49.7-56.8	1.91	55.3	53.9-57.2	1.4
Pre anal length	78.6	76.4-80.8	1.27	79.0	78.4-79.9	0.6
Pre anus length	67.7	64.9-70.9	2.01	68.1	65.8-69.8	1.7
Width of mouth in % of HW	53.3	53.4-55.6	1.06	68.9	66.7-70.7	2.1
Head depth as % of HL	61.9	54.1-66.7	3.89	68.8	68.5-69.1	0.2
Interorbital width	21.9	16.3-25.3	2.72	28.7	24.6-31.5	2.9

description of the holotype by Kottelat (1990), who described the species partially from the specimen which was in very bad shape (as his photograph shows). Menon (1987) noted that the species had a cup-shaped (labial structure) with a greatly hypertrophied upper lip. Kottelat (1990), on the other hand, wrote that the lips are thick. Both the authors showed a cup-shaped mouth with greatly hypertrophied lips (Menon's pl. 6, fig. 8; Kottelat's fig. 45), which were the reproductions of Hora's (1929) drawings. The present specimens (Fig. 2a) do not have such a structure.

Schistura McClelland

Schistura McClelland, 1838: 944, 947 (type species: *S. rupecula* McClelland); Kottelat, 1990: 90 (revision): Banarescu & Nalbant, 1995: 438 (generic classification).

Diagnosis: Mouth wider than long, lower lip medially interrupted, but not forming two lateral triangular pads; a black bar (sometimes dissociated) on caudal fin base; 2 black marks along the base of dorsal fin; body with black transverse bars, split in many. Posterior nostril prolonged into a tube in some. Sexual dimorphism not seen in most species; pectoral fin rays may be ossified and covered with breeding tubercles in males. Body covered with embedded scales.

The counts are: D. ii-iii, 7½-9½, A. ii-iii, 5½, C/8-9+7-8/, P. 9-12, V. 6-8.

In all the species found in Manipur, the following observations were made. Branched dorsal fin number is an important specific character. Dorsal fins are inserted midway between tip of snout and caudal fin base, except in *S. prashadi* where they are inserted slightly ahead. Anterior nostrils are pierced obliquely in the front side of a flap-like nasal tube. There are 3 pairs of barbels, inner and outer rostrals and a maxillary. Processus dentiformes are developed in all the species except in *S. prashadi* in which it is reduced. A black spot is present at the base of first few dorsal rays, except in *S. scaturigina*.

Local name: Commonly called Ngatup in Manipur; Moremlei, Khirilei or Hankorkhai in Tangkhul dialect.

Key to species

1. Branched dorsal rays 9½ .... *S. prashadi*
   Branched dorsal fin rays 7½-8½.................... 2
2. Branched dorsal rays 7½, lateral line incomplete 3
   Branched dorsal rays 8½, lateral line complete or incomplete 4
3. Body with 8-11 broad transverse bars with narrow interspace .... *S. kanjupkhulensis*
   Body with 17-21 narrow irregular bars, often breaking up into mottles, sometimes plain and dusky .... *S. manipurensis*
4. Lateral line incomplete. 11-12 broad transverse bars with narrow interspace .... *S. nagaensis*
5. Transverse bars in two rows, one extending from back to lateral line, alternating with another from lateral line towards belly, no black spot at base of first few dorsal fin rays .... *S. scaturigina*
   Transverse bars regularly arranged, black spot present at base of first few dorsal fin rays...... 6
6. Transverse bars 9, depth of body 14.6% of SL .... *Schistura* sp.
   Transverse bars more than 9, depth of body 15.7-18.2% of SL 7
7. 17-20 transverse bars extending from back to belly, interspace of similar width ....
   .... *S. sikmaiensis*
   Transverse bars wide in caudal peduncle, gradually narrowing anteriorwards, bars broken up into characteristic reticular network in front of dorsal fin origin .... *S. vinciguerra*

Schistura kanjupkhulensis (Hora)

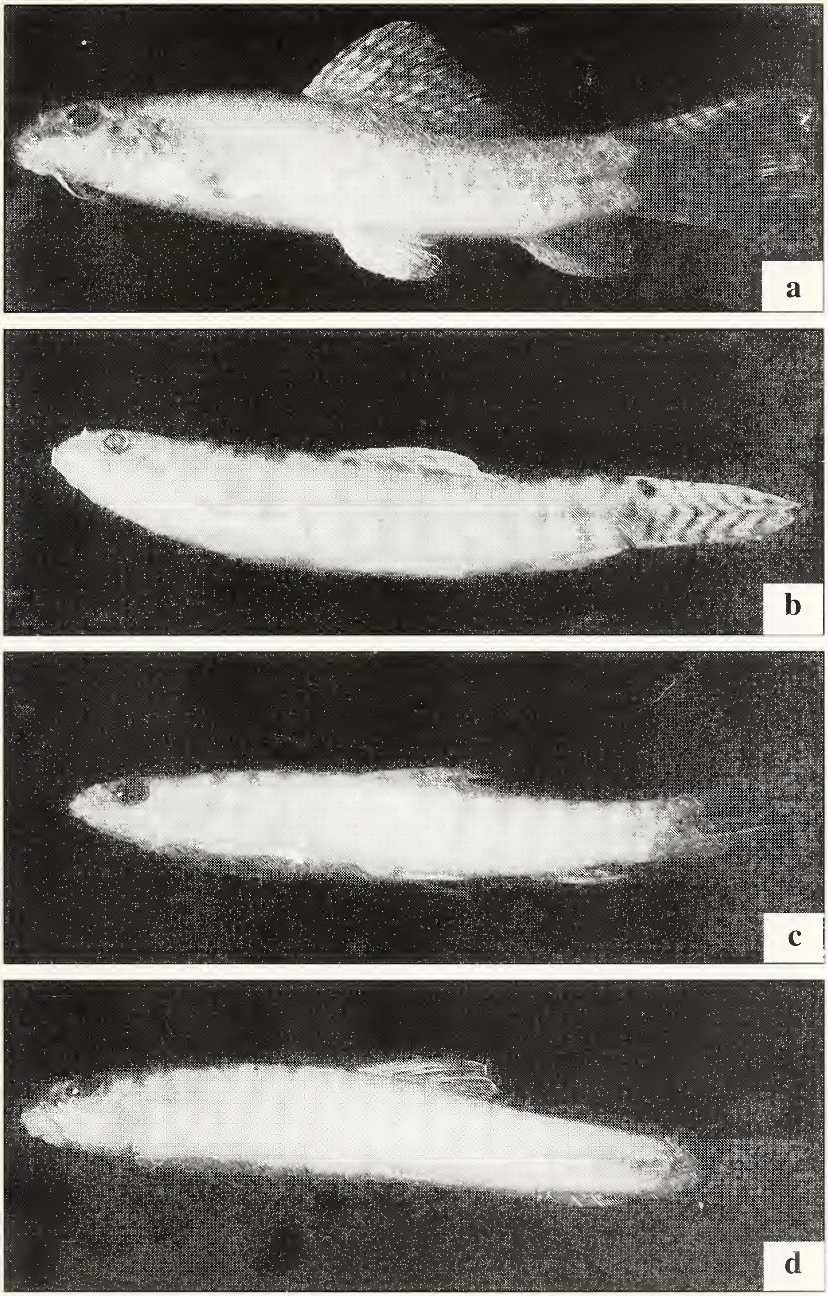
(Plate 2, Fig. a)

Nemacheilus kanjupkhulensis Hora, 1921: 202, pl. 10, figs. 4, 4a (type locality: Yairibuk, Manipur).

Nemacheilus kanjupkhulensis: Menon, 1987: 115 (diagnosis and description)

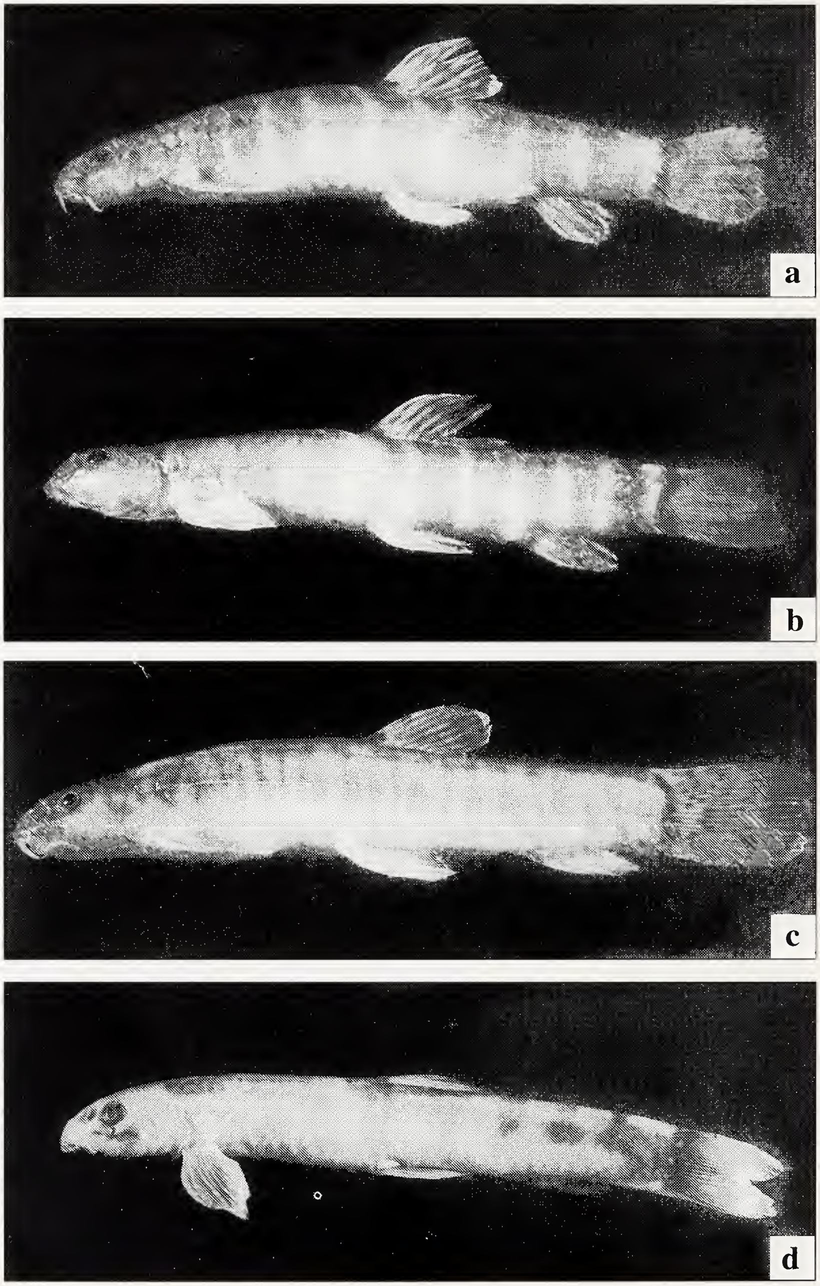
Schistura kanjupkhulensis: Kottelat, 1990: 131 (revision); Banarescu & Nalbant, 1995: 439, fig. 10 (generic classification and illustration)

W. Vishwanath *et al.*: *Acanthocobitis* sp. and *Neonoemacheilus* sp. PLATE 1



Figs a-d: a. *Acanthocobitis botia* (MUMF 3015), 62.8 mm SL;
b. *A. zonalternans* (uncatalogued), 42.1 mm SL;
c. *Neonoemacheilus assamensis* (MUMF 3011), 38.8 mm SL; d. *N. peguensis* (MUMF 3012), 41.7 mm SL

W. Vishwanath *et al.*: *Schistura* sp. PLATE 2



Figs a-d: a. *Schistura kanjupkhulensis* (MUMF 2040), 45.0 mm SL;
b. *S. nagaensis* (MUMF 2074), 41.4 mm SL; c. *S. manipurensis* (uncatalogued) 54.0 mm SL;
d. *Schistura* sp. (MUMF 3009), 54.0 mm SL

Material examined: Unreg. 5, 30.3-49.8 mm, Chakpi stream, WM, 12.xi.1992; unreg. 1, 36.0 mm, Maklang R., KS, 25.iv.1995; 3007, 3, 42.5-46.3 mm, Khujairok, WV & party, March, 1998.

Diagnosis: *Schistura* with 7½ branched dorsal fin rays, 8-11 broad black bars on body alternating with narrower and pale yellow interspace; body depth 17.1 (15.0-19.3)% of SL. Caudal fin truncate.

Sexual dimorphism: Not known.

Colour: Body yellowish with 8-11 broad brown transverse bars, alternating with narrow interspace. Bands usually not broken up. Caudal base with a continuous darker bar. A dark spot at base of first few dorsal rays. Distinct series of longitudinal dark spots in upper 2/3rd of dorsal fin, another fainter one near outer border. Caudal fin with 2-3 irregular vertical bands. Fins and some parts of body orange in live condition.

Distribution: INDIA: Chindwin basin of Manipur.

Remarks: Morphometric data given in Table 3. Distributed in the streams of the Manipur central valley and of those draining into the Yu R. of Myanmar. Menon (1987) described *Noemacheilus* (now *Schistura*) *nagaensis* from Tizu R., Nagaland. Kottelat (1990) doubted its validity and recorded it as synonymous with *S. kanjupkhulensis* with a question mark. The species is considered valid in this work, it is discussed in detail and described.

Schistura manipurensis (Chaudhuri)
(Plate 2, Fig c)

Nemachilus manipurensis Chaudhuri, 1912: 443, pl. 40 fig. 4, pl. 41 fig. 1 (type locality: Manipur)

Noemacheilus manipurensis: Menon, 1987: 121, pl. 12 fig. 4 (diagnosis and description)

Schistura manipurensis: Kottelat, 1990: 156, fig. 114, 115 (revision)

Material examined: Unreg., 3, 29.3-40.3 mm, Chapki Str., WM, 16.ix.1992; MUMF 2079, 1, 56.5 mm, Challou R., Thetsi, LK, 2.vi.1994; MUMF 2155-59, 5, 38.0-56.0 mm, Tizu R., 15.viii.1994, MUMF 2201, 9, 35.0-55.0 mm, Tizu R., 17.vi.1997, MUMF 2272, 1, 54.3 mm, Str. Near Tolloi, 12.xi.1997; Unreg., 7, 30.2-59.2 mm, Challou R., Chingal, 30.iv.1995; Unreg., 6, 35.0-51.2 mm, Wanze Str., Khamsom, 8.i.1996; all LK, Unreg., 1, 56.4 mm, Chatrickong R., KS, 6.vi.1996; MUMF 3001, 6, 35.4-59.8 mm; Khujailok, WV & party, March, 1998.

Diagnosis: *Schistura* with 7½ branched dorsal rays, males with suborbital flap, *processus dentiformes* reduced, lateral line incomplete, extending up to pelvic origin, a dark spot at base of first few dorsal fin rays, body with dark thin bars, usually broken up, may be plain dusky, caudal fin slightly emarginate to truncate.

Sexual dimorphism: Males with a large suborbital flap.

Colour: Body pale yellowish, with 17-21 thin transverse bars, irregular, extending from back to caudal base, a black spot at base of first few dorsal rays. Dorsal fin with 2 horizontal bars, one in the middle and another near outer border, caudal with irregular transverse bars.

Distribution: INDIA: Chindwin basins of Nagaland and Manipur.

Remarks: Chaudhuri (1912) reported the type locality as Manipur, Assam, without mentioning the drainage. Manipur was a part of Assam in British India. Now it is a State of the Indian Union. Hora (1921) obtained the information from Dr. Annandale and reported that the fish was collected by Rev. Pettigrew from Ukhrul district. All the streams and rivers in the district belong to the Chindwin basin. Specimens examined by Menon (1987) and Kottelat (1990) were also from the same basin. Thus, distribution of the species in Brahmaputra basin as reported by them is not valid. Morphometric data given in Table 4.

Schistura nagaensis (Menon)
(Plate 2, Fig b)

Noemacheilus nagaensis Menon, 1987; 117 (type locality: Phodung R., tributary of Tizu R., Nagaland).

Material examined: MUMF 2074-78, 5, 31.5-41-0 mm, Challou R, Thetsi, 2.vi.1994; MUMF 2218-32, 15, 31.5-50.0 mm, Wanze stream, Khamsom, 2.i.1995; MUMF 2270-71, 2, 50.0-54.0 mm, Str. Near Tolloi, 12.xi.1997; Unreg., 3, 47.8-48.0 mm, Momo stream, Tusom CV, 2.iii.1998 (all Coll. LK); ZSIF 10061, 2, Zu zeti Str. (Larur), Nagaland, JH Hutton, 1927.

Diagnosis: *Schistura* with 7½ branched dorsal fin rays, 9-11 broad, dark, transverse bars on body, alternating with narrower white/pale yellow interspace; body depth 14.6 (13.9-15.3)% of SL. Caudal fin truncate, lateral line incomplete.

Sexual dimorphism: Not known.

Colour: Body yellowish-white with 9-11 broad, dark brown, transverse bands alternating with narrow interspace. Caudal base with a dark continuous bar. Black spot at the base of first few dorsal rays, horizontal dark bar near outer border of dorsal fin.

Distribution: INDIA: Tizu River and its tributaries in Nagaland and Manipur (Chindwin basin).

Remarks: Morphometric data given in Table 3. Menon (1987) described the fish based on 14 specimens from Phodung River, a tributary

TABLE 3
MORPHOMETRY OF *S. KANJUPKHULENSIS* AND *S. NAGAENSIS* (IN % OF SL EXCEPT SL IN MM)

	S. kanjupkhulensis (N=11)			*S. nagaensis* (N=25)		
	Mean	Range	S.D.	Mean	Range	S.D.
Standard Length		42.6-46.3			33.4-44.6	
Depth of Body	17.1	15.0-19.3	1.8	14.6	13.9-15.3	1.1
Lateral headlength	22.0	21.2-22.5	0.6	22.7	20.9-24.3	1.3
Dorsal headlength	19.5	19.0-19.8	0.4	20.3	19.2-21.6	0.9
Head depth (at nape)	14.8	11.9-20.2	0.2	11.6	9.4-12.9	0.7
Head depth (at eye)	10.0	9.3-10.8	0.6	10.2	9.6-10.8	0.6
Snout length	8.8	8.2-9.2	0.4	8.7	8.1-9.0	0.4
Eye Diameter	3.1	2.8-3.3	0.2	4.2	3.4-5.1	0.3
Interorbital width	5.5	5.2-5.8	0.2	5.1	4.9-5.2	0.3
Maximum head width	14.6	14.4-14.8	0.2	13.7	12.8-14.4	0.7
Head width (at nares)	10.0	9.3-10.6	0.5	9.0	8.1-9.9	0.7
Mouth gape width	7.7	7.4-8.0	0.2	6.1	5.4-6.6	0.5
Internarial width	3.8	3.8-3.9	0.0	4.1	3.4-4.5	0.5
Length of caudal peduncle	14.5	13.8-15.1	0.5	14.3	14.1-14.4	0.1
Height of caudal peduncle	12.2	11.7-12.6	0.4	11.1	10.8-11.4	0.2
Body width(at dorsal origin)	13.3	11.3-14.8	1.5	11.8	11.3-12.1	0.4
Body width (at anal origin)	9.0	8.2-9.5	0.6	8.7	8.4-8.9	0.2
Predorsal length	52.0	51.2-52.8	0.5	51.7	50.6-52.9	0.9
Prepelvic length	53.2	51.6-54.9	1.4	53.2	52.7-53.9	0.5
Pre anal length	76.5	74.6-78.0	1.4	77.2	76.5-78.6	1.0
Pre anus length	75.3	74.5-77.7	1.4	74.1	72.5-75.9	1.4
Length of upper caudal lobe	18.7	17.7-19.3	0.7	18.4	15.9-20.7	1.2
Length of lower caudal lobe	19.6	19.0-20.0	0.4	19.2	17.7-20.7	1.2
Length of pectoral fin	18 .0	17.1-19.0	0.8	18.4	17.5-19.8	1.0
Length of ventral fin	15.5	14.5-16.2	0.7	16.8	16.5-17.4	0.4
Length of anal fin	11.3	10.6-11.9	0.5	12.9	12.6-13.1	0.2
Length of dorsal fin base	13.7	13.2-14.3	0.7	16.2	15.7-16.8	0.5
Height of dorsal fin	13.9	11.4-15.5	0.5	16.1	15.0-18.3	1.6

TABLE 4
MORPHOMETRIC DATA OF *S. MANIPURENSIS* AND *SCHISTURA* SP. (IN % OF SL EXCEPT SL IN MM.)

	S. manipurensis (N=39)			*Schistura* sp. (N=1)
	Mean	Range	S.D.	
Standard Length		35.4-59.8		54.0
Depth of Body	15.9	14.2-17.7	1.1	14.6
Caudal length	21.4	19.5-22.5	1.0	—
Lateral headlength	20.2	11.6-22.9	0.9	20.7
Dorsal headlength	19.3	18.4-20.1	0.6	20.6
Head depth (at nape)	12.5	12.3-12.7	0.1	11.9
Head depth (at eye)	10.2	9.8-10.9	0.4	9.8
Snout length	8.7	8.4-9.0	0.2	8.5
Eye Diameter	3.1	2.2-3.7	0.5	3.3
Interorbital width	7.8	7.0-8.5	0.5	5.7
Maximum head width	16.0	13.8-18.4	1.5	13.0
Head width (at nares)	11.2	10.5-11.7	0.4	9.1
Mouth gape width	6.9	6.5-7.4	0.3	7.0
Internarial width	5.7	4.5-6.1	0.5	2.8
Length of caudal peduncle	12.1	11.6-13.4	0.6	15.4
Height of caudal peduncle	11.7	11.0-12.3	0.5	11.5
Body width (at dorsal origin)	11.7	9.9-13.1	1.1	11.3
Body width (at anal origin)	7.7	7.1-8.4	0.4	7.6
Predorsal length	52.8	50.6-54.5	1.3	50.2
Prepelvic length	49.7	48.3-50.3	0.7	51.7
Pre anal length	78.2	77.5-78.8	0.5	75.6
Pre anus length	74.4	72.5-76.0	1.3	71.1
Length of upper caudal lobe	21.4	19.5-22.7	1.0	19.4
Length of lower caudal lobe	20.9	19.1-22.6	1.1	19.6
Length of pectoral fin	19.0	17.9-20.4	0.8	17.6
Length of ventral fin	18.3	16.9-19.5	0.7	15.9
Length of anal fin	10.4	8.4-12.6	1.4	13.5
Length of dorsal fin base	11.0	10.2-12.1	0.6	11.7
Height of dorsal fin	13.4	11.5-15.0	1.6	13.1

of Tizu River, Nagaland, collected by J.H. Hutton in March, 1927. He separated the species from *S. kanjupkhulensis* (Hora) as having 8 vs 7 branched dorsal rays. Two of Hutton's specimens (ZSIF 10061) collected from Zu Zeti Str., (tributary of Tizu R., near Myanmar border) in 1927 were examined and found to have 8½ branched dorsal rays. We observed certain differences between *S. kanjupkhulensis* and *S. nagaensis* (mean ±S.D.) in respect of depth of body (19.1 ±1.8 vs. 14.6 ±0.6); depth of head (14.8 ±0.2 vs. 11.6 ±1.6) and mouth width (7.7 ±0.2 vs. 6.1 ±0.5)% of SL. These differences were not noticed by Menon (1987) because of the wide range in his data, probably because he also examined small (juvenile), old and badly preserved specimens.

Menon's (1987) statement that *S. nagaensis* replaces *N. kanjupkhulensis* in Nagaland drainage into the Brahmaputra system needs reconsideration. In fact, Tizu River (type locality of *S. nagaensis*) originates in the Tuensang District of Nagaland. It then forms the interstate boundary between Nagaland and Manipur and finally flows into the Chindwin in Myamar. Thus, the species under description is a Chindwin form and not Brahmaputra form as reported by Menon (op. cit.), which confused Kottelat (1990).

Schistura prashadi (Hora)
(Plate 3, Fig a)

Nemachilus prashadi Hora, 1921: 203, Pl. 10 fig. 2 (type locality: Thonagpal tank, Thoubal and Sikmai streams, Manipur).

Noemacheilus prashadi: Menon, 1987: 127 (diagnosis and description).

Schistura prashadi: Kottelet, 1990: 191 (revision); Banarescu & Nalbant, 1995: 440 (generic classification). Kosygin & Vishwanath, 1998: 243 (report from Nagaland)

Material examined: MUMF 296, 6, 48.7-53.1 mm, Chakpi stream at Mombi, WM, 12.xi.1992, MUMF 2070-73, 4, 34.0-36.5 mm, Challou R. Thetsi, 2.vi.1994, MUMF 2268, 1, 49.0 mm, Wanje Str., Khamsom, 5.ii.1997, Unreg., 3, 48.6-59.5 mm, Momo stream, Tusom CV, 2.iii.1998, all by LK; Unreg., 2, 43.2-52.3 mm, Chatrickong R., KS, 2.ii.1997.

Diagnosis: *Schistura* with 9½ branched dorsal rays, complete lateral line, a distinct black

spot at base of first few dorsal rays, complete or slightly broken black caudal bar, colour pattern consisting of transverse bars laterally, reticulated spots dorso-laterally, and 1-2 V-shaped dark transverse bars on caudal fin, the tips pointing towards body. Caudal fin forked, lateral line complete.

Sexual dimorphism: Males with suborbital flap, its edge with tubercles, pectoral rays with tubercles on dorsal surface.

Colour: Body yellowish-white with 10-12 dark brown bars extending from slightly above the lateral line towards the level of paired fin origins. Irregular or reticulated spots present from back to lateral line. Caudal bar darker, complete or slightly interrupted. Dorsal fin with black spot at base of first few rays, two horizontal dark bars in the middle. Two V-shaped vertical dark bars on caudal fin, one in the middle and another near posterior margin, apex of both pointing towards body.

Distribution: INDIA: Chindwin basin of Manipur.

Remarks: Morphometric data given in Table 5. All the specimens examined had 9½ branched dorsal rays as observed by Kottelat (1990). Hora (1921) and Menon (1987) reported only 8, which needs examination. The species is not represented in our collections from Brahmaputra basin so far.

Schistura scaturigina (McClelland)
(Plate 3, Fig b)

Cobitis scaturgina McClelland, 1839: 308, 443, pl. 53, fig. 6 (type locality: Ganga ?)

Noemacheilus scaturigina: Menon, 1987: 86, pl. 3, figs. 2, 3; pl. 13, figs. 8, 9 (diagnosis and description)

Material examined: MUMF 3008, 1, 41.00 mm, Tuivai R., HL. March 1997.

Diagnosis: *Schistura* with 8½ branched dorsal rays, elongated head, snout and pectoral fin, no black spot at base of first few dorsal fin rays, caudal fin forked.

Sexual dimorphism: Unknown.

Colour: Body yellowish-white with 12 transverse triangular bars extending from lateral line downward. Bars tend to break up anteriorly. Back and dorsolateral sides with irregular spots and bands. Black bar at base of caudal fin interrupted. Dorsal fin dusky, caudal fin with 2-3 irregular transverse dark bands.

Distribution: INDIA: Ganga and Brahmaputra basins.

Remarks: Morphometric data given in Table 5. The present specimens agree with the description by Menon (1987) except for the missing black spot at base of dorsal fin rays. Although Menon's (1987) drawing of the species (Pl. III Fig. 20) shows the spot, his photograph in pl. XIII Figs. 8, 9 do not show clear dark spots. The specimen examined was from Tuivai R., a tributary of the Barak (Brahmaputra basin). The fish is very similar to *S. prashadi* in its general body shape and coloration. We agree with Banarescu and Nalbant (1995) in including both the species in the *Scaturigina* group.

Schistura sikmaiensis (Hora)
(Plate 3, Fig c)

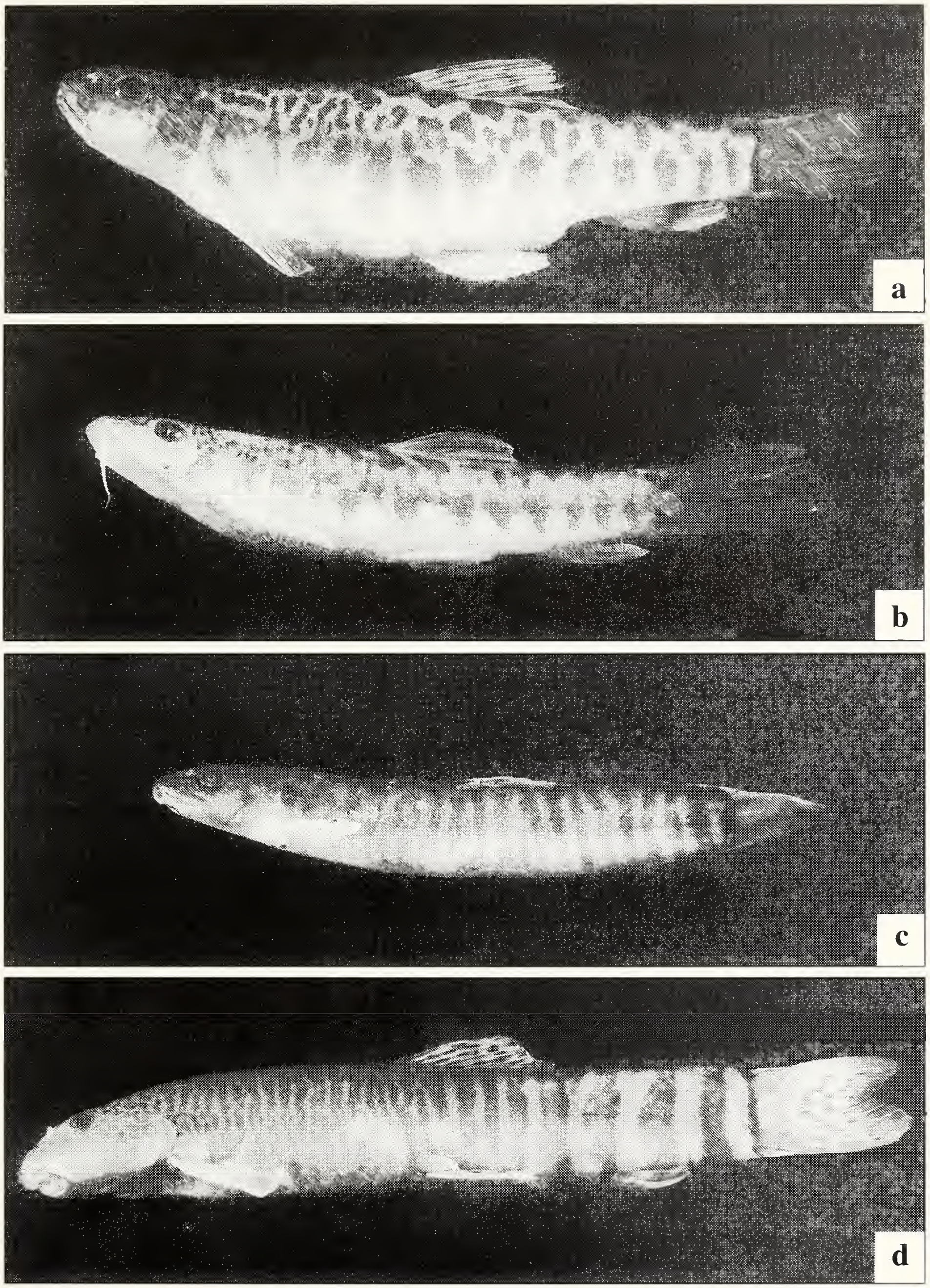
Nemacheilus sikmaiensis Hora, 1921: 201, Pl. 9 fig. 4, Pl. 10 fig. 1 (type locality: Sikmai stream near Pallel, Manipur)

Noemacheilus sikmaiensis: Menon, 1987: 125, Pl. 3 figs. 4, 5 (diagnosis and description)

Schistura sikmaiensis: Kottelat, 1990 (revision).

Material examined: Unreg., 16, 31.2-69.0 mm, Chakpi stream, Mombi (tributary of Manipur R, WM, 16.ix.1992; MUMF 2150-2154, 5, 43.0-56.0 mm, Challou R., Thetsi, LK, 15.viii.1994; MUMF 3003, 1, 92.3 mm, Leimatak R., WJ & SB, 17.v.1999; MUMF 3004, 1, 56.8 mm, Moreh, WV & party, 24.iii.1999; MUMF 3005, 1, 74.1 mm, Litan Str., KS, 25.iii.1999.

W. Vishwanath *et al.*: *Schistura* sp. PLATE 3



Figs a-d: a. *Schistura prashadi* (uncatalogued), 59.2 mm SL; b. *S. scaturigina* (MUMF 3008), 41.0 mm SL; c. *S. sikamaiensis* (uncatalogued), 42.1 mm SL; d. *S. vinciguerrae* (uncatalogued), 68.2 mm SL

TABLE 5
MORPHOMETRIC DATA OF *S. PRASHADI* AND *S. SCATURIGINA* (IN % OF SL EXCEPT SL IN MM.)

	Schistura prashadi (N=16)			*S. scaturgina* (N=1)
	Mean	Range	S.D.	
Standard Length		34.0-59.5	41.0	
Depth of Body	20.7	19.2-24.1	1.8	19.0
Lateral headlength	22.9	22.2-24.3	0.6	24.7
Dorsal headlength	20.2	19.3-20.9	0.6	22.2
Head depth (at nape)	14.9	12.6-17.2	1.2	13.9
Head depth (at eye)	12.3	11.5-14.2	1.0	10.6
Snout length	8.7	7.6-9.5	0.7	10.1
Eye Diameter	4.8	4.2-5.2	0.3	4.6
Interorbital width	6.2	5.6-7.0	0.5	5.6
Maximum head width	14.4	13.3-15.9	0.9	15.2
Head width (at nares)	9.5	9.3-10.0	0.2	8.4
Internarial width	5.2	5.1-5.4	0.1	5.4
Length of caudal peduncle	14.8	13.6-17.1	1.3	12.0
Height of caudal peduncle	11.0	10.1-11.7	0.5	11.2
Body width (at dorsal origin)	14.5	13.8-15.2	0.6	15.9
Body width (at anal origin)	9.2	8.7-10.2	0.5	8.8
Predorsal length	46.4	44.7-47.6	1.1	50.7
Prepelvic length	53.6	52.6-55.6	1.0	54.4
Pre anal length	76.2	74.2-77.4	1.1	79.8
Pre anus length	71.3	69.2-76.6	1.6	71.2
Length of upper caudal lobe	23.2	22.6-23.8	0.5	-
Length of lower caudal lobe	23.1	22.3-23.8	0.5	-
Length of pectoral fin	22.4	21.6-23.1	0.6	22.7
Length of ventral fin	18.0	16.9-18.7	0.7	19.0
Length of anal fin	14.1	13.5-14.6	0.5	18.8
Length of dorsal fin base	19.0	17.7-20.2	0.9	15.9
Height of dorsal fin	18.9	16.4-20.6	1.4	20.5

Diagnosis: *Schistura* with blunt, rounded head and snout, no *processus dentiformes*, 17-20 transverse bars on body extending from back to belly, interspace of similar or slightly smaller width, black caudal bar complete, a black spot on the base of first few dorsal rays. Body elongate, tubular in front of dorsal fin, compressed behind, head slightly depressed. Caudal fin deeply emarginated or forked, lateral line complete.

Sexual dimorphism: Males with suborbital flap.

Colour: Body light brown with 17-20 dark olivaceous transverse bars extending from back to belly, interspace with similar or slightly smaller width. A dark, complete bar on caudal base. A black spot at base of first few dorsal fin rays. Dorsal fin with 2 horizontal dark lines in the middle. Other fins dusky. Body and fins orange in live fish.

Distribution: INDIA: Brahmaputra basin in Assam, Meghalaya, Tripura, Nagaland, Manipur; Chindwin basin in Manipur; Southwest Yunnan and Myanmar in the vicinity of Myitkyina and Putao.

Remarks: Morphometric data are given in Table 6. The species is very widely distributed, i.e., both in the Barak and Chindwin basins of Manipur. Kottelat (1990) doubted the identity of specimen reported by Menon (1987) from Brahmaputra basin. The present description is based on both Barak (Brahmaputra) and Chindwin basins of these States.

Schistura vinciguerrae (Hora)
(Plate 3, Fig d)

Nemachilus multifasciatus (non Day, 1978): Vincigerra, 1890: 337 (Meekalan, Thagata Juva).

Nemachilus vinciguerrae Hora, 1935: 62, pl 2 fig. 12 (type locality: Meekalan, Burma).

Noemacheilus vinciguerrae: Menon, 1987: 134, pl. 4 fig. 3 (diagnosis and description).

Schistura vinciguerrae: Kottelat, 1990: 218, pl. 5. figs.164, 165 (revision).

Material examined: MUMF 2180-2189, 10, 65.0-79.5 mm; Wanze stream, Khamsom, LK, 2.i.1995; Unreg., 10, 43.3-57.4 mm; Maklang R., KS, 25.viii.1995.

Diagnosis: *Schistura* with 8½ branched dorsal fin rays, distinctive colour pattern: dark,

TABLE 6
MORPHOMETRIC DATA OF *SCHISTURA SIKMAIENSIS* AND *S. VINCIGUERRA*
(IN % OF SL EXCEPT SL IN MM)

	S. sikmaiensis (N=24)			*S. vinciguerra* (N=20)		
	Mean	Range	S.D.	Mean	Range	S.D.
Standard length		31.2-92.3			43.3-79.5	
Depth of body	16.6	15.7-17.4	0.5	17.6	16.9-18.2	0.5
Lateral headlength	24.0	23.4-24.6	0.5	22.8	21.3-24.2	1.2
Dorsal headlength	22.0	21.7-22.3	0.3	19.1	18.2-19.9	0.7
Head depth (at nape)	13.9	12.6-14.9	0.2	12.8	11.9-13.8	0. 8
Head depth (at eye)	12.0	11.2-12.4	1.1	10.5	8.7-12.0	1. 6
Snout length	10.8	10.0-11.6	1.8	8.0	7.5-8.4	0.4
Eye Diameter	3.5	3.0-3.9	0.4	3.8	3.0-4.6	0.7
Interorbital width	6.0	5.2-6.6	0.2	5.8	5.7-6.0	0.1
Maximum head width	16.4	14.8-18.0	1.3	13.5	12.9-14.5	1.1
Head width (at nares)	12.3	10.2-14.3	1.8	9.7	9.6-10.0	0.2
Mouth gape width	8.7	7.6-9.8	0.9	6.4	5.9-6.7	0.4
Internarial width	4.8	4.2-5.8	0.5	4.2	3.8-4.8	0.4
Length of caudal peduncle	11.9	11.2-12.5	0.8	14.5	13.9-14.8	0.4
Height of caudal peduncle	13.8	12.8-14.0	0.5	13.7	12.6-14.7	0.9
Body width (at dorsal origin)	15.1	13.7-16.5	1.2	13.4	11.7-14.5	1.2
Body width (at anal origin)	9.8	8.3-11.2	1.2	9.0	7.9-9.6	0.8
Predorsal length	51.6	50.7-52.5	0.8	50.0	48.3-51.8	1.4
Prepelvic length	55.4	54.9-55.8	1.4	54.3	52.4-55.5	1.4
Pre anal length	79.5	77.9-81.0	1.4	80.3	80.0-80.7	1.3
Pre anus length	73.2	71.8-74.6	1.2	74.0	73.5-74.4	0.4
Length of upper caudal lobe	19.9	18.6-21.1	1.3	21.7	20.3-23.3	1.2
Length of lower caudal lobe	19.3	18.2-20.4	1.2	22.6	21.7-23.1	1.3
Length of pectoral fin	16.0	14.5-17.4	1.2	19.5	18.4-20.1	0.8
Length of ventral fin	14.1	13.8-14.4	0.5	17.0	16.4-17.7	0.5
Length of anal fin	11.8	10.7-12.6	0.8	14.1	12.7-15.5	1.1
Length of dorsal fin base	16.1	15.5-16.6	1.3	16.0	14.8-16.7	0.9
Height of dorsal fin	16.7	14.6-18.7	2.0	15.5	12.9-16.9	1.9

wide transverse bars with wide interspaces behind, gradually narrower in front; 2-3 bars united dorsally in front of doral fin, usually forming reticulations. Caudal fin forked, lateral line complete.

Sexual Dimorphism: Not known.

Colour: Body yellowish, with 10-16 dark transverse bars, as wide as interspace in caudal peduncle, gradually narrow anteriorly. Bars unite dorsally in front of dorsal fin origin, usually reticular. A black spot at base of first few dorsal rays; one horizontal dark band across dorsal fin and 2 V-shaped bars across the caudal fin.

Distribution: INDIA: Origin of Challou River (near Sirohi Hills), a tributary of Tizu River; Maklang and Namya Rivers all Chindwin headwaters in Manipur; Irrawady and Salween basins in Myanmar and Irrawady basin in China.

Remarks: Menon (1987) examined 6 specimens from Manipur, which were probably obtained by a field worker (who came to Manipur in 1985) from M. Gonchandra Sharma, who was collecting fish from Tarest stream, which drains the Ukhrul and Chandel Districts and joins the Yu river (tributary of Chindwin in Myankar). Kongan thana is a small village in the eastern part of Ukhrul District. Namya River, like Taret stream flows into Yu river. Thus, Menon's (1987) and Hora's (1937) references of the locality in Myanmar are wrong.

***Schistura* sp.**
(Plate 2, Fig d)

Material examined: MUMF 3009, 1 male, 54.0 mm, tributary of Irang R. at Langkha, MG, 1989.

Diagnosis: An elongated form of *Schistura*, its body depth at dorsal origin 14.6% of SL, ventral profile flat and straight, short fins, 8½ branched dorsal ray, male with suborbital flap, complete lateral line, 9 broad transverse dark bands extending from back towards belly, broader dorsally, tapering gradually, a black spot at base of first few dorsal rays, caudal fin forked.

Sexual dimorphism: Only one specimen, probably male, was available for examination. It has a prominent suborbital flap.

Colour: As in diagnosis. In addition, body dark brown from back to lateral line, pale yellowish ventrally. Caudal fin with irregular horizontal dark bands.

Distribution: Manipur: Lankha stream, tributary of Irang (Tamenglong District).

Remarks: The specimen does not match any known species of *Schistura*. It is elongated, its fins short and with a characteristic colour pattern. Pending collection and observation of more specimens, new specific status cannot be given. Morphometric data given in Table 4.

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DISTRIBUTION AND REGENERATION OF *HOLOPTELEA INTEGRIFOLIA* PLANCH. IN ALWAR DISTRICT, RAJASTHAN[1]

A.S. Yadav[2]

(*With three text-figures*)

Key words: Age structure, grazing, natural regeneration, samara, seedling population

Studies indicate that the distribution of *Holoptelea integrifolia* (Family: Ulmaceae) is restricted to hilly areas and reserve forests of Alwar district, Rajasthan. Although this species produces an enormous number of fruits (samara) per unit area, only a fraction of them form seedlings. Dry spells and high temperature in the monsoon, low temperature and soil moisture content in winter, dry and hot summer, and grazing adversely affect seedling survival. Observations from the four study sites (Dhobighatta hills, Sagar hills, Garvaji, R.R. College campus) in Alwar district, Rajasthan indicate that natural regeneration of *H. integrifolia* is taking place only in areas which are partially or fully protected against biotic disturbances.

Introduction

Holoptelea integrifolia grows in northeast Rajasthan and is reported to be the tallest tree in the region (Sharma and Tiagi, 1979). Unfortunately, despite being a fast growing, local tree species, it has not found use in afforestation. The extensive felling and lopping of *H. integrifolia* trees for timber and firewood has reduced its distribution in Alwar district, Rajasthan. It is, therefore, imperative to analyse the factors that are responsible for the poor regeneration of *H. integrifolia*.

Study Area

Four sites were selected to study the natural regeneration of *Holoptelea integrifolia*. Two of these sites were located in hilly areas. The first site was an east facing slope at Dhobighatta hills, 6 km from Raj Rishi (R.R.) College, a highly disturbed area subjected to tree felling, and grazing by cows and goats. *Wrightia tinctoria* and *Butea monosperma* (Table 1) dominated the plant community. *H. integrifolia* grew from the base to the middle of the hill slope. Most of them were young and produced as a result of coppicing of the felled trees. The soil was shallow, sandy loam mixed with gravel and small stones (Table 2). The second site was a northeast-facing slope at Sagar hills, about 5 km from R.R. College. It was declared a reserve forest by the Govt. of Rajasthan in 1984. Since then, it is fully protected with no major biotic disturbance. It is dominated by *Wrightia tinctoria* and *Anogeissus pendula* bushes (Table 1). *H. integrifolia* grew from the base to the middle of the hill slope. The soil type is similar to that of Dhobighatta hills (Table 2).

The other two sites were situated in plain areas, the first was the campus of R.R. College, surrounded by a high wall from all sides. The college campus was an orchard previously surrounding the palace of the Maharaja of Alwar, which was later rented to the Govt. of Rajasthan to house the R. R. College. The orchard was abandoned for 50 years, and is now converted into a forest dominated by *H. integrifolia* (Table 1). It is partially disturbed as about 10 buffaloes, 6 cows and 50 goats are allowed to

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TABLE 1

DENSITY AND FREQUENCY (%) OF *HOLOPTELEA INTEGRIFOLIA* AND ITS ASSOCIATED SHRUBS AND TREES AT THE FOUR STUDY SITES (±S.E.)

Plant species	Dhobighatta hills		Sagar hills		R.R. College		Garvaji	
	Density	Frequency	Density	Frequency	Density	Frequency	Density	Frequency
Abutilon indicum	-	-	-	-	4.5 ±2.8	20	-	-
Acacia leucophloea	0.7 ±0.3	40	-	-	-	-	0.9 ±0.2	70
Adhatoda vasica	18 ±2.2	100	44 ±11.9	100	8.2 ±5.2	30	53 ±12	100
Anogeissus pendula	5 ±1.7	60	10 ±1.9	80	-	-	2.7 ±0.5	100
Butea monosperma	2 ±0.6	70	0.4 ±0.3	10	-	-	-	-
Capparis sepiaria	4 ±0.4	100	-	-	5.6 ±1.8	70	-	-
Cassia fistula	0.1 ±0.09	10	-	-	0.4 ±0.2	30	-	-
Cordia dichotoma	-	-	-	-	0.3 ±0.1	30	-	-
Grewia flavescens	-	-	0.7 ±0.2	50	-	-	-	-
Hibiscus micranthus	1.2 ±0.2	80	2.4 ±0.7	60	-	-	-	-
Holoptelea integrifolia	3.1 ±0.4	70	17.3 ±1.3	100	11.4 ±1.3	100	1.4 ±0.1	60
Lantana camara	-	-	-	-	24.3 ±3.1	100	-	-
Prosopis juliflora	-	-	-	-	1.9 ±0.7	50	-	-
Wrightia tinctoria	14 ±2.3	90	13 ±1.7	100	-	-	-	-
Ziziphus nummularia	-	-	-	-	18.4 ±9.2	50	2.8 ±3.7	20

TABLE 2
PHYSICO-CHEMICAL CHARACTERISTICS OF THE FOUR STUDY SITES

Site	pH	E.C.	Organic Carbon (%)	Phosphorus kg/ha	Potassium kg/ha
Dhobighatta hills	7.8	0.38	0.45	63	240
Sagar hills	8.0	0.50	0.13	54	260
R.R. College campus	7.8	0.30	0.40	72	High
Garvaji	7.9	0.30	0.42	18	High

graze and trees are felled for timber and firewood. The soil is deep, well developed sandy loam (Table 2). The second site was located at the base of the hills near the Garvaji temple, 14 km from Alwar city. *Adhatoda vasica* dominated the plant community here (Table 1). The site is highly disturbed by tree felling and heavy cattle and goat grazing.

MATERIAL AND METHODS

The distribution of *Holoptelea integrifolia* in Alwar district was studied by visiting important locations in all the subdivisions and consulting the forest range officers of Alwar district. Its natural regeneration was studied in the four selected study sites in different locations. The density and frequency of *H. integrifolia* and its associated shrubs and trees was estimated at all four sites by laying 15 quadrats of 10 m x 10 m each. The circumference of the plants was measured at a height of 1 m for trees and just above the ground for seedlings and saplings.

From a known cohort of one year old plants, it was observed that the maximum circumference of a year old plant was 1.08 cm. Therefore, three age groups of *H. integrifolia* were identified in a population. One year old plants with 1 cm circumference, saplings with 1 to 31.5 cm and trees with 31.5 cm girth (Saxena *et al.* 1978).

The samara is a one seeded, dry, indehiscent, winged fruit. The production per plant was estimated by laying down 20 quadrats of 10 m x 10 m each, for each study site when the fruit was almost mature in the last week of March, 1998. The number of samara per fertile plant were estimated as follows:

Total samara production =
No. of primary branches per fertile plant x
No. of secondary branches per primary branch x
No. of tertiary branches per secondary branch x
No. of samara per tertiary branch.

Further observations were taken from three study sites — Dhobighatta hills, Sagar hills and R.R. College campus. The number of samara present on the soil surface was estimated by laying down 20 quadrats of 1 m x 1 m after its dispersal was almost over in the last week of April, 1998. Monsoon set in the last week of June in 1998, and after 10 days of sufficient rainfall, the number of established seedlings were estimated by laying down 20 quadrats of 1 m x 1 m in all the three study sites.

Survival of established seedling populations of *H. integrifolia* was studied at R.R. College and Sagar hills. Seedling establishment was almost negligible at Dhobighatta hills. Since seedling density was very low at R.R. College, four permanent quadrats of 1 m x 1 m were laid down where the density of *H. integrifolia* seedlings was maximum, whereas five permanent quadrats of 1 m x 1 m were laid down at random at Sagar hills where seedling recruitment was uniform and good throughout.

The physico-chemical parameters of all the four study sites were analysed by taking five soil samples from each site at random, from an area of 10 cm x 10 cm x 10 cm. Soil samples from each study site were mixed and analysed at the Soil Testing Laboratory, Agriculture Department, Govt. of Rajasthan, Alwar. To evaluate the effect

TABLE 3
SAMARA (FRUIT) PRODUCTION BY *HOLOPTERA INTEGRIFOLIA* (±S.E)

Site	Plants /100 sq. m	Fertile Plants /100 sq. m	No. of samara per plant (x10^3)	No. of samara /100 sq. m (x10^3)
Dhobighatta hills	3.1 ±0.4	1.5 ±0.47	3	4
Sagar hills	17.3 ±1.3	0.6 ±0.15	9	5
R.R. College campus	11.4 ±1.3	0.7 ±0.2	19	13
Garvaji	1.4 ±0.1	1.2 ±0.18	273	328

of soil moisture content on seedling survival, five soil samples were taken from 0-10 cm depth from the vicinity of the permanent quadrats whenever required. The soil moisture content was estimated by the method of Mishra (1968).

RESULTS

Distribution: *H. integrifolia* grows in most parts of Alwar district (Fig. 1) It is particularly abundant in the hilly tracts. Since it is not a climax species, it grows in deforested areas, treefall gaps and along water channels in the Sariska Tiger Reserve. The highest density of *H. integrifolia* was observed at Sagar hills, whereas the lowest was at Garvaji (Table 1).

Samara production and dispersal: 85%, 48%, 3.5% and 6% plants of *H. integrifolia* were fertile at Garvaji, Dobhighatta hills, Sagar hills and R.R. College respectively (Table 3). Maximum samara production per plant was at Garvaji, whereas it was very low at Sagar hills and Dhobighatta hills (Table 3). Number of samara reaching the soil surface after dispersal was highest at Sagar hills and lowest at Dhobighatta hills (Table 4).

Establishment and survival of seedlings: *H. integrifolia* seedlings established well at Sagar hills, but almost negligibly at Dhobighatta hills (Table 4). Only 5% and 46% seedlings survived at R.R. College and Sagar hills respectively beyond the first week of establishment. Seedling population experienced less mortality from August to December 1998. An increase, however, was observed in January 1999, at both the study sites. All the seedlings at R.R. College died by January 1999, while 20 seedlings /100 sq. m survived up to June 1999 at Sagar hills (Fig. 2).

Age structure: Age-structure analysis of *H. integrifolia* populations showed that the one year age group was present only at Sagar hills (Fig. 3). The saplings were present in all the study sites except Garvaji where both seedlings and saplings were absent. Among the other three study sites, R.R. College had the highest, i.e. 4.4 saplings /100 sq. m; followed by Sagar hills where 2.4 saplings /100 sq. m were recorded. The maximum density of the tree age group was 7 trees /100 sq. m at R. R. College.

DISCUSSION

The Alwar district survey suggests that *H. integrifolia* grows luxuriantly around Alwar and Rajgarh towns, and deforested areas protected by the forest department. It is also found

TABLE 4
REGENERATION POTENTIAL OF *HOLOPTERA INTEGRIFOLIA* /100 SQ. M

Study Site	Samara reaching soil surface	No. of seedlings established	No. of seedlings survived after one year
Dhobighatta hills	360	Negligible	Nil
Sagar hills	2,810	1,070	20
R.R. College campus	2,108	386	Nil

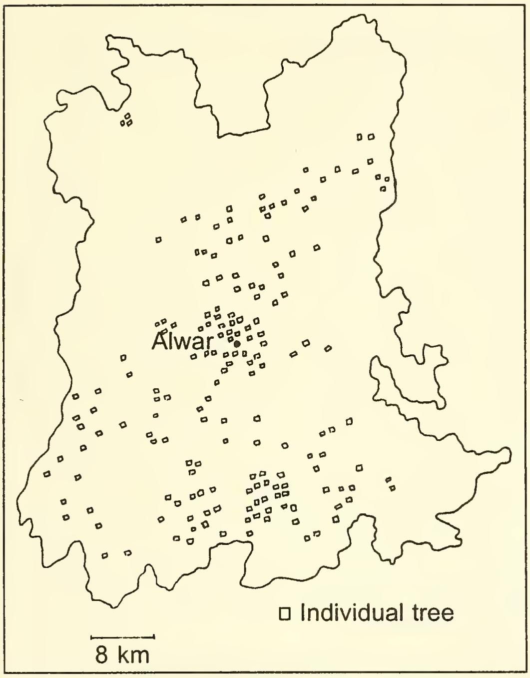

Fig. 1: Map of Alwar district showing the distribution of *H. integrifolia*

growing along roadsides, railway lines and around human habitations in hilly regions. It is almost absent in the plains of Behror, Tijara, Kishangarh and a part of Luxmangarh subdivisions (Fig. 1).

The high percentage of fertile plants in Garvaji and Dhobighatta hills and low percentage at Sagar hills and R.R.College, suggests that grazing by goats and cattle destroy the seedlings and saplings in these formerly disturbed areas. The samara production per plant was maximum at Garvaji site because all the fertile plants were full grown trees, whereas it was less at R.R.College, a large number of fertile plants being younger. In hilly areas, samara production was low due to the stunted growth of the trees.

Of the total samara production per unit area, only a small fraction reached the soil surface at Dhobighatta hills and R.R.College, may be due to the open habitat where seeds are widely dispersed by wind. However, more than 50% of samara produced per unit area reached the soil surface at Sagar hills because of the small size of the site, northeast direction of the slope and hills surrounding the western and northern sides.

Percentage of seedlings established per unit area of the soil surface was very low, suggesting that a large number of seeds were eaten by goats, rodents and red ants. Some might have been washed away by the rains. This was confirmed experimentally in August 1998, with 9 samples, each with 50 samara, placed at different locations at R.R. College. After 4 days it was observed that 24% samara were damaged, their seeds removed by rodents or damaged by small red ants. After 10 days, the rest of the seeds were lost. They might have been washed away in the rains which continued for three days. Loss of seeds due to heavy rain has been reported for other tree species (Dagar *et. al.* 1978). The poor establishment of seedlings at R.R. College may also be due to the destruction of all the seeds of a tree by some insect. Whitefly epidemic in *H. integrifolia* has been reported by Mishra and Mishra (1995). However, at Sagar hills about 40% of seeds reaching the soil surface were established as seedlings (Table 4). This may be due to the protection of the site against grazing, absence of rodents and other seed predators, as large numbers of healthy seeds were present at the commencement of rains. The loss of samara due to monsoon run off may be prevented by small stones, pebbles and shrubs.

Seedling survival was very low in all the three study sites, as only a few seedlings survived over a year at Sagar hills. The mortality rate was highest in the dry periods of the rainy season when the soil moisture was very low (Table 5) and the soil surface temperature was above 41 °C at R.R. College. It was observed that most of the seedlings died due to permanent wilting. However, seedling mortality rate was less at

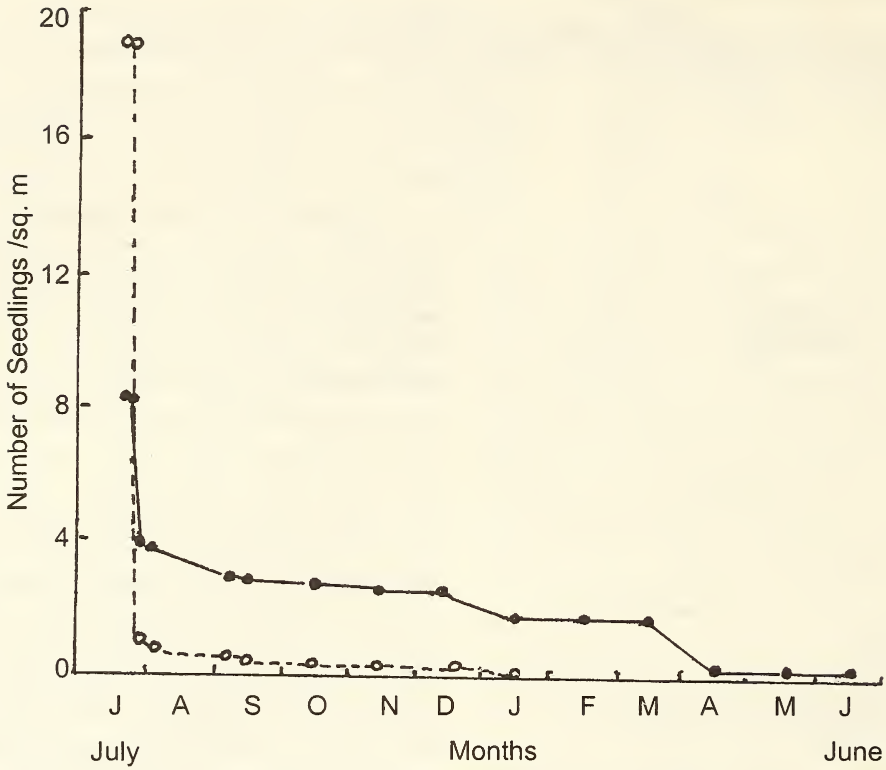

Fig. 2: Survival of seedling population of *H. integrifolia* at R.R. College campus (O--------O) and Sagar hills (●——●)

Sagar hills, perhaps due to the protective shrub cover like *Wrightia tinctoria* and *Adhatoda vasica*. Second to the monsoon, the seedlings experienced greatest mortality in January, when the soil moisture was low and temperature dropped below 4 °C. This is in conformity with the high seedling mortality due to low soil moisture and low temperature in other tree species (Tripathi and Khan 1992, Rao *et. al.* 1997).

TABLE 5
SOIL MOISTURE CONTENT (%) OF R.R. COLLEGE CAMPUS AND SAGAR HILLS

Observation Periods	Sagar hills	R.R.College Campus
24 hours after rainfall on 17th July, 1998	13.5	11.6
7 days after rainfall on 24th July, 1998	2.6	3.8
In dry winter season on 21st February, 1999	5.90	4.2

The age-structure of *H. integrifolia* population at different sites suggests that its natural regeneration is taking place only at Sagar hills and R.R. College campus because the former is fully and the latter partially protected against biotic disturbance. Seedlings and saplings were absent at the overgrazed Garvaji and Dhobighatta hills, indicating the role of biotic disturbance in regeneration of *H. integrifolia*. This was confirmed when it was noticed that *H. integrifolia* is not preferred by grazing animals, but in the absence of green vegetation, goats and cattle grazed on it. It may be concluded that some seedlings of *H. integrifolia* may be damaged by the trampling of cattle. This tree species grows at places beyond

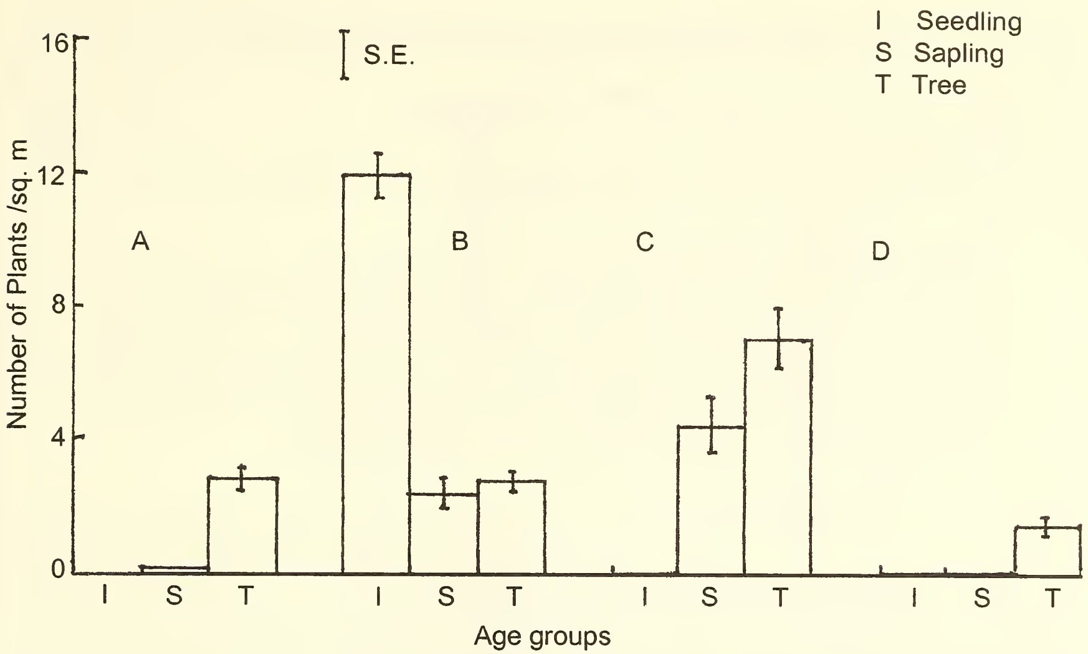

Fig. 3: Population age-structure of *H. integrifolia* at (A) Dhobighatta hills (B) Sagar hills (C) R.R. College campus and (D) Garvaji.

the reach of man or grazing animals, such as crevices of rocks, on steep slopes and among thorny bushes. It was concluded that the natural regeneration of *H. integrifolia* is adversely affected by both abiotic and biotic factors, and takes place only in areas which are partially or fully protected against grazing.

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FOOD HABITS OF THE RED PANDA, *AILURUS FULGENS* IN THE SINGHALILA NATIONAL PARK, DARJEELING, INDIA[1]

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(*With one text-figure*)

Key words: Red panda, *Ailurus fulgens*, diet, eastern Himalaya, temperate zone, subalpine zone

Food habits of the red panda in the Singhalila National Park (SNP) were investigated at three sites from 1994 to 1996, by examining 1,250 droppings or faeces. Red panda was found to consume two species of bamboo, *Arundinaria maling* and *A. aristata*, which dominated the understorey of SNP, along with seasonal supplements of some fruits and shoots of the above mentioned bamboo species. However, the composition of the diet differed between the sites. The difference in their dietary composition in relation to the overall ecology of the red panda in the SNP needs further investigation.

Introduction

The red panda belongs to the Order Carnivora, but interestingly subsists on a herbivorous diet, specifically on bamboo leaves. Although the modifications of dentition and skull structures have typical herbivorous features, the digestive system is ill-adapted for proper utilization of its low nutrient diet of bamboo (Roberts and Gittleman 1984, Bleijenberg and Nijboer 1989). The gut is short and simple, typical of the carnivores, and devoid of cellulose digesting microbes (Roberts and Gittleman 1984, Schaller *et al.* 1985). As a result, the red panda consumes a large amount of bamboo to fulfill its energy requirement (Oftedal *et al.* 1989). The red panda has evolved a physiological adaptation of lowering the metabolic rate to cope with low nutrient diet, reducing energy expenditure for maintenance and reproduction (McNab 1989). This evolutionary strategy results in a long gestation period, low fecundity and slow postnatal growth, which place constraints on the rapid propagation of its population (McNab 1989). Moreover, the bamboo mass flowers periodically, and dies after the seeds are produced (Janzen 1976). The panda faces scarcity of food during the flowering stage of the bamboo. This paper presents preliminary findings on the food and feeding habits of red panda studied during a research project (1993-1996) in the Singhalila National Park (SNP), Darjeeling, eastern Himalaya, India.

Study area

The SNP (87° 59'-88° 53' E; 26° 31'-27° 31' N) ranges from 2,400 to 3,600 m above msl, encompassing the temperate zone and subalpine zones. The moist temperate climate of SNP varies with altitude. The observed summer temperature ranged from 7 to 17 °C, and winter temperature dropped as low as 1 °C in the temperate zone. Average summer and winter temperature in the subalpine region were 7 °C and 1 °C respectively. Mean annual rainfall was 350 cm and average humidity ranged from 83% to 96%.

The intensive study area comprised of three sites (Fig. 1). Sites 1 and 2 represented the

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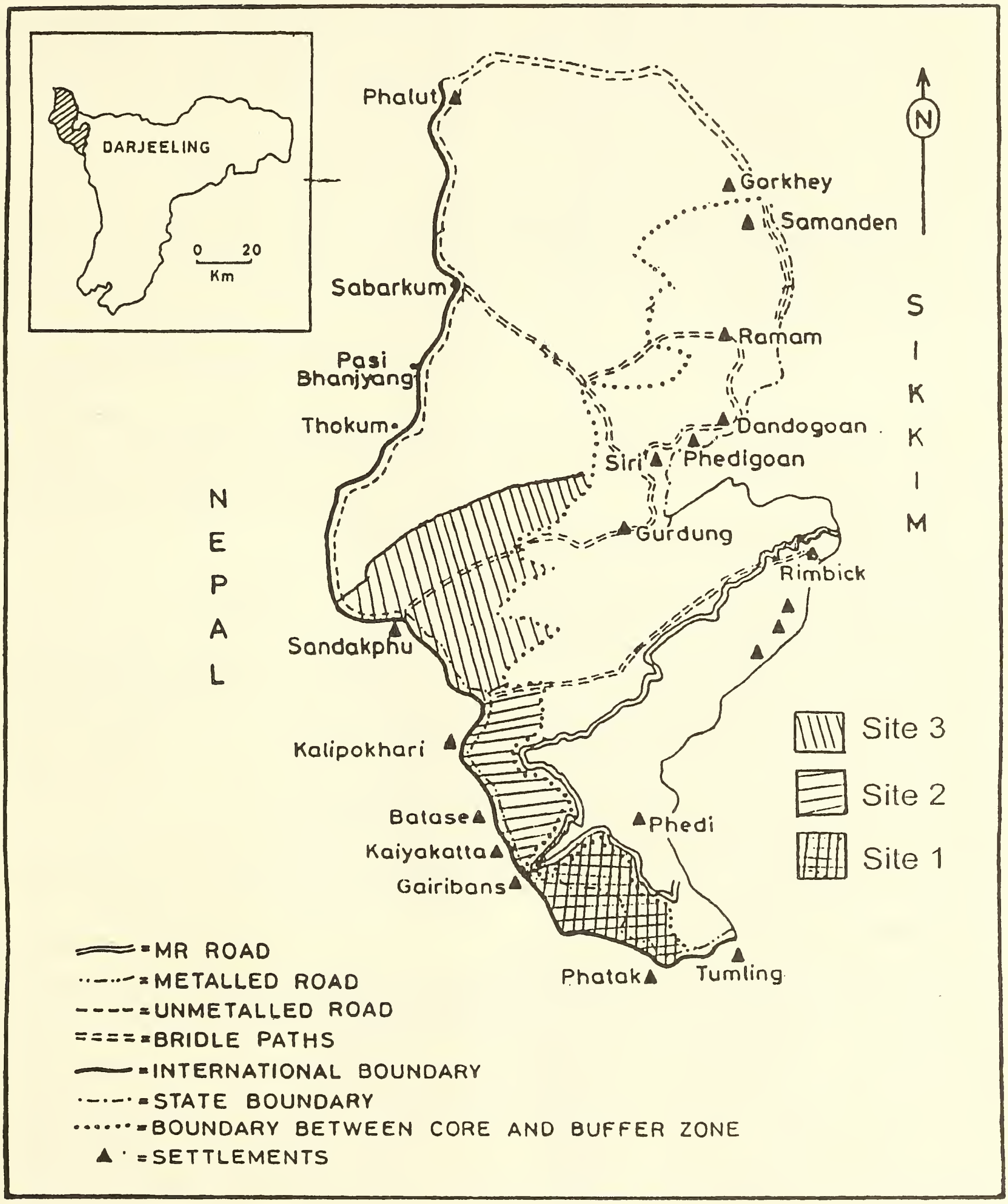

Fig. 1: Singhalila National Park, Darjeeling, India.

temperate zone, and Site 3 the subalpine zone. Trees such as *Quercus* spp. dominated the temperate zone, *Arundinaria maling* being dominant in the understorey. In the higher reaches of the temperate zone, *Quercus* spp. were scarce, and the vegetation was dominated by *Sorbus*, *Acer* and *Vitex*. The understorey was composed of both *Arundinaria maling* and *A. aristata*. The subalpine zone had a prominent association of trees such as *Abies densa*, *Betula utilis* and *Rhododendron* spp., with an understorey of *A. aristata*.

Methods

Red panda food habits and nutritional status of food plants were investigated by the following methods:

Phenology of the food plants: In order to investigate the availability of cover and food resources in the study area, phenological studies were undertaken (Pradhan 1999). The fruiting seasonality of the food plants is presented here. Phenology and recruitment rates of the two bamboo species were studied in sixty 1 sq. m plots, thirty each for the two species. Initially, all the bamboo culms in the 1 sq. m plots were counted and monitored monthly. When the shoots appeared, they were counted and labelled. After that, all the labelled shoots were monitored to assess their survival and death.

Faecal analysis: Red panda pellets were collected monthly, broken and macroscopically examined. While the leaves of the two bamboo species could be identified macroscopically, the shoots of both the species were not identifiable. The fruits and berries consumed were identified from the seed remains, undigested skin of the fruits and even sheaths, which survived digestion. Each food item was expressed by its frequency of occurrence and by percent volume, computed for each season from the entire study area. Thus, the diet spectrum of red panda was also investigated for the three study sites within two broad vegetation zones — the temperate and subalpine zones separately. The difference in intake of two bamboo species was tested using Mann-Whitney U test following Fowler and Cohen (1986).

Nutritional analysis: Leaves of both species of bamboo, of all age classes (1 year, 2 year, and >2 years), were collected every month for a year. Fruits of *Actinidia strigosa*, *Sorbus microphylla* and *Rosa* spp., and shoots of both bamboo species were collected during their season of emergence. All the plant samples were dried to a constant weight at 55 °C and ground in Willey's mill prior to analysis. Hemicellulose, cellulose and lignin were determined following Goering and Van Soest (1970), using Fibertech System. Crude protein was determined following Allen (1989).

Results

A total of 1,250 pellets were examined. It was found that the red panda in the SNP consumed both the species of bamboo. The difference between the intake of the leaves of the two species was, however, not statistically significant (Mann-Whitney; $z = 0.24$, $df = 12$, $p = 0.813$). Along with the bamboo leaves, some seasonal fruits and shoots of the bamboo species were also consumed by the red panda.

Availability and distribution of food: The bamboo species *A. maling*, locally known as *maling* had an average height of 4.9 ±0.80 m and a diameter of 1.5 ±0.73 cm. The average number of nodes was 22 with an average sheath length of 22 cm. *A. aristata*, locally known as *ratonigalo* was shorter, with an average height of 3.9 ±0.053 m. The average number of nodes was 22; average sheath length 12.81 cm. *A. aristata* had a higher density of culms than *A. maling*.

A. maling was the dominant bamboo

between 2,600 m to 3,100 m in the study area. *A. aristata* was found from 2,850 m, but actually dominated the understorey from 3,150 m to 3,600 m. Shoots of *A. maling* appeared annually between early June and October, whereas the shoots of *A. aristata* emerged from late June to October. The recruitment rate of bamboo (*A. maling* and *A. aristata*) was low, with an average of 1.92 /sq. m, out of which only 0.98 / sq. m remained intact. Of the bamboo shoots monitored, 48% were eaten by insects and other animals, and 9.8% were broken accidentally. The bamboo shoots collected by the locals was 10.96 kg/family.

In the temperate zone, the fleshy fruit of *Actinidia strigosa*, a creeper was found to be an important component of the red panda's post-monsoon diet. *A. strigosa* was found between 2,800 m and 3,100 m in the study area. *A. strigosa* started fruiting from September, matured around October, and the fruits lasted till November. The fruits of *A. strigosa* had a thin skin and were sweet when ripe, they were much sought after by the locals to add flavour to their liquor. An estimated amount of approximately 3.75 kg/family was collected by the locals during its fruiting season. *Sorbus microphylla* started fruiting from June to July and was found from 3,200 m to 3,600 m. *Rosa sericera*, a shrub in disturbed areas, fruited from June to November.

Seasonal variation in diet: The diet of the red panda in SNP varied seasonally (Table 1). In pre-monsoon, its diet was a combination of 52% *A. aristata* and 48% *A. maling* leaves by volume. In the monsoon, it fed on *A. aristata* and *A. maling* leaves, bamboo shoots and traces of an unidentified fruit. In post-monsoon, food variety increased with the availability of fruit resources in the forest. Red panda was found to consume *A. aristata* leaves (45%), *A. maling* leaves (35%), fruits of *Actinidia strigosa* (13%) bamboo shoots (6%), *Sorbus microphylla* and *Rosa sericera* in trace amounts. The winter diet consisted of *A. aristata* leaves (53%) and *A. maling* (47%).

The overall intake of *A. aristata* varied from 34.86% to 53% (x = 45.97%), while *A. maling* varied from 36.18% to 48.16% (x = 41.97 %), and the rest (x = 11.82%) consisted of fruits and bamboo shoots. No evidence of large scale carnivory was found in the faecal pellets, except for a few bird feathers.

Feeding ecology in the three study sites: The diet showed seasonal differences in proportions of different food items consumed at the three study sites (Table 2). At Site 1, it comprised of *A. maling* leaves (100%) in the premonsoon and winter seasons. In the monsoon, it fed on *A. maling* leaves (61%), bamboo shoots (38%) and unidentified fruit (1.1%). The post-monsoon diet was composed of *A. maling* leaves (70%), *A. strigosa* fruits (20%)

TABLE 1

INCIDENCE OF FOOD ITEMS IDENTIFIED IN 1,250 RED PANDA DROPPINGS BY NUMBER OF DROPPINGS AND % VOLUME (IN BRACKETS) IN SINGHALILA NATIONAL PARK

Food items	Pre-monsoon (Mar-May)		Monsoon (June-Aug)		Post-monsoon (Sept-Nov)		Winter (Dec-Feb)	
Arundinaria maling	295	(48.16)	98	(36.18)	120	(34.57)	85	(47.0)
Arundinaria aristata	385	(51.84)	80	(34.86)	105	(44.70)	112	(53.0)
Bamboo shoots	0	(0)	53	(28.58)	22	(6.23)	0	(0)
Actinidia strigosa	0	(0)	0	(0)	27	(13.33)	0	(0)
Sorbus microphylla	0	(0)	0	(0)	0.6	(0)	0	(0)
Rosa sericera	0	(0)	0	(0)	1.0	(trace)	0	(0)
Unidentified fruit	0	(0)	0	(0)	10	(trace)	0	(0)
Total number of droppings	632		188		235		195	

Trace = less than 1.00%

TABLE 2

SEASONAL INCIDENCE OF FOOD ITEMS IN RED PANDA DROPPINGS BY NUMBER OF DROPPINGS AND % VOLUME (IN BRACKETS) FROM THREE STUDY SITES IN SINGHALILA NATIONAL PARK

	Site 1				Site 2				Site 3			
Food items	PR	MN	PM	W	PR	MN	PM	W	PR	MN	PM	W
Arundinaria maling	122	68	90	52	156	42	35	33	0	0	0	0
	(100)	(60.6)	(70)	(100)	(45.5)	(38.8)	(33.8)	(41)	(0)	(0)	(0)	(0)
Arundinaria aristata	0	0	0	0	111	38	24	35	270	42	85	77
	(0)	(0)	(0)	(0)	(54.4)	(46)	(44)	(59)	(100)	(74.6)	(91)	(100)
Bamboo shoots	0	30	8	0	0	24	9	0	0	10	7	0
	(0)	(38.3)	(10)	(0)	(0)	(15.3)	(2.2)	(0)	(0)	(25.3)	(6.7)	(0)
Actinidia strigosa	0	0	0	0	0	0	9	0	0	0	0	0
	(0)	(0)	(20)	(0)	(0)	(0)	(20)	(0)	(0)	(0)	(0)	(0)
Sorbus microphylla	0	0	0	0	0	0	0	0	0	0	3	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(1.73)	(0)
Rosa sericera	0	0	0	0	0	0	0	0	0	0	1	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(trace)	(0)
Unidentified fruit	1	8	10	0	0	0	0	0	0	0	0	0
	(trace)	(1.1)	(trace)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Total droppings	122	68	97	52	240	79	53	65	270	42	85	77

Trace = less than 1.00%

PR= Pre-monsoon, MN=Monsoon, PM = Post-monsoon, W = Winter

and bamboo shoots (10%).

At Site 2, red panda was found consuming *A. aristata* (54%) and *A. maling* (46%) leaves in premonsoon, and about the same proportion of the same leaves in winter. The monsoon diet was composed of *A. aristata* leaves (46%), *A. maling* leaves (39%) and bamboo shoots (15%), while the postmonsoon diet was *A. aristata* (44%), *A. maling* (34%) leaves, *A. strigosa* (20%) and bamboo shoots (2%).

At Site 3, the diet consisted entirely of *A. aristata* leaves (100%) during premonsoon and winter. In the monsoon, the pellets were found to have *A. aristata* leaves (75%) and bamboo shoots (25%). Postmonsoon samples of Site 3 consisted of *A. aristata* leaves (91%), bamboo shoots (6.7%), *S. microphylla* (1.73%) and *R. sericera* in trace amounts of 0.57%.

Nutritive value of the food plants: *A. maling* leaves were found to have higher cellulose and lignin content (40.12% of the dry matter) than *A. aristata* (31.83%). The crude protein and lignin content of *A. maling* leaves was 15.1 % and *A. aristata* leaves was 14.2%. Fruits of *A. strigosa* seem to be nutritionally richer, with high and crude protein, and low cellulose and lignin content, as compared to *S. microphylla* and *R. sericera* (Table 3).

DISCUSSION

Macroscopic examination of faeces, as done in this study, has also been used successfully by Reid *et al.* (1991), and Yonzon and Hunter (1991) in describing the red panda's diet. Red panda consumed both the species of bamboo present in the SNP, which formed the chief food,

TABLE 3

PROTEIN, HEMICELLULOSE, CELLULOSE AND LIGNIN CONTENT (% DRY MATTER) OF THREE FRUITS EATEN BY THE RED PANDA IN SINGHALILA NATIONAL PARK

Fruit	Crude Protein	Hemicellulose	Cellulose+lignin
Actinidia strigosa	10.63	8.00	20.59
Sorbus microphylla	4.38	2.54	41.00
Rosa sericera	8.88	1.95	28.01

especially during the premonsoon and winter periods. Seasonal fruits such as *A. strigosa* and *S. microphylla*, and bamboo shoots supplemented the diet of bamboo leaves during the monsoon and the postmonsoon period. The monsoon and postmonsoon coincided with the period of birth and rearing of the young of red panda. Earlier studies specify leaves and shoots of *Sinarundinaria fangiana*, and shoots of *Fargesia spathecea* to be taken in the Wolong Nature Reserve (China), (Schaller *et al.* 1985, Johnson *et al.* 1988, Reid *et al.* 1991) and a species of bamboo locally known as *jhapra* in the Langtang National Park, Nepal (Yonzon and Hunter 1991). Fruits and berries of *Sorbus* spp., *Maddenia hypoleuca*, *Cotoneaster moupinensis*, *Clematoclethera tiliaceae*, *Rubus mesogaeus*, *R. pileatus*, *Ribes moupinense*, *Prunus vaniotti* and *P. brachyoda* and even mushrooms are reported to be taken by the red panda in the wild (Johnson *et al.* 1988, Reid *et al.* 1991, Yonzon and Hunter 1991).

Feeding ecology in the three study sites of SNP: The amount of *A. aristata* leaves taken by the red panda in the SNP was slightly higher than *A. maling*, although the difference is not statistically significant. It was not possible to say how particular they were about selecting the bamboo species. Red panda was found to be consuming mainly *A. maling* leaves in Site 1, the dominant species in the area, as *A. aristata* was found only in patches above 2,850 m. At Site 2, both *A. maling* and *A. aristata* leaves were consumed because of the increasing availability of *A. aristata* as compared to that in Site 1. At Site 3, the diet was solely composed of *A. aristata* leaves, the dominant bamboo species of the area.

The giant panda selected *Sinarundinaria* sp. over *Fargesia* sp. in the Choushuigou study area in China, where both species were easily accessible, perhaps due to the higher protein, other nutrients and less cellulose, lignin and better balance of essential amino acids in *Sinarundinaria* sp. (Schaller *et al.* 1985). However, the pandas in Jiuzhaigou (China) and elsewhere subsisted entirely on the *Fargesia* sp. which was regarded an adequate food (Schaller *et al.* 1985).

The topography of the study area was such that the two species of bamboo were not equally abundant in any of the three sites. *A. maling* dominated Site 1. At Site 2, both *A. maling* and *A. aristata* were found. *A. aristata* dominated Site 3. From the results of Site 1 and Site 3, it could be tentatively said that the red panda was consuming the species of bamboo most easily available. Investigation of the food quality of plants ascertained that *A. aristata* leaves had higher levels of protein, less of cellulose and lignin as compared to *A. maling*. However, not much could be inferred about the food preference on the basis of nutrient content, as *A. maling* and *A. aristata* leaves were taken in almost equal quantity at Site 2. Moreover, *A. maling* and *A. aristata* leaves seemed an adequate diet at Site 1 and Site 3 respectively.

Fruits of *A. strigosa* formed an important supplement to the red panda diet. However, more can be said of the selection of fruits only by comparing the preference and avoidance of other fruits found within a site rather than between sites. For example, within Site 1 and Site 2, other fruits, which the red panda may have consumed, were *Holbellia latifolia* and *Sorbus cuspidata*. But faecal examinations showed that these fruits were not taken, despite their abundance. The nutritional analysis of other fruits was beyond the scope of the present study.

Both species of bamboo have been affected by intensive cattle grazing, and they were also found to have low recruitment rate. The bamboo shoots of both *A. maling* and *A. aristata* were not only eaten by other wild animals, but also harvested by the locals. All these factors could have an effect on their growth dynamics and need further studies. *A. strigosa* is also harvested by the locals in significant quantity.

This study finally reveals that the diet of the red panda in the temperate zone consisted of *A. maling* and *A. aristata* leaves and shoots, and fruits of *A. strigosa*, whereas in the subalpine zone, *A. aristata* leaves, shoots and fruits of *S. microphylla* and *R. sericera* were consumed. The difference in the dietary composition in relation to the overall ecology of the red panda in the Singhalila National Park needs further study.

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FRESHWATER CLADOCERANS (CRUSTACEA: BRANCHIOPODA) OF THE WETLANDS OF INDIAN BOTANICAL GARDEN, HOWRAH, WEST BENGAL[1]

K. VENKATARAMAN[2] AND S.R. DAS[3]

(*With one text-figure*)

Key words: Cladoceran fauna, Indian Botanical Garden, West Bengal India

The Indian Botanic Garden located on the northern bank of the river Hooghly, Howrah district, West Bengal consists of twenty-five wetlands of varying sizes. To study the Cladoceran fauna, four perennial lakes and ponds were selected. The survey was repeated for three different periods: April 1994, September 1994 and March 1995. Of the 38 species of Cladocera, belonging to 6 families and 24 genera, recorded in the present study, three are new records to West Bengal and one — *Diaphanosoma leuctenbergianum*, is a new record to India. All the four species have been described in detail to facilitate identification. Except for a few species of Cladocera, most Chydorids occur in wetlands with specific macrophytes. The association between Cladocera and macrophytes suggests a specific interrelationship, which is yet to be established.

INTRODUCTION

The Indian Botanic Garden located on the northern bank of the River Hooghly, Sibpur, Howrah district, West Bengal, is a unique repository of valuable and rare plant species, with a mosaic of twenty-five wetland areas covering 11 ha. These lakes are interconnected by an operational subterranean flushing system linked with the Hooghly river on the southeast (Fig 1). The physico-chemical nature of these wetlands and their effects were studied by Singh and Ghosh (1985). An attempt to study the fauna of the wetland has been initiated by the Botanical Survey of India and the Zoological Survey of India, under the directive of the Ministry of Environment & Forests. Of these twenty-five wetlands, most of the perennial lakes are used for fish culture regularly. To study the biodiversity of the wetlands, four perennial fish culture lakes and temporary ponds each were selected. The diversity of crustacean zooplankton, especially Cladocera, is being dealt with here.

MATERIAL AND METHODS

A total of 8 wetlands, four perennial (fish culture) lakes: 1) Dhobi 2) Kings 3) Leeram and 4) Prain lake and four temporary ponds: 1) Sector 12 pond, 2) Lotus pond at sector 11, 3) Sector 9 pond and 4) Sector 8 pond were selected for the present study (Fig. 1). Three surveys were conducted in different seasons: April 19-22, 1994, September 27-30, 1994 and March 8-10, 1995. All the perennial lakes and temporary ponds harbour macrophytes such as *Eichhornia crassipes* and *Microcystis auriginosa* among others. The electrical conductivity was 1530 to 5200 μ mhos and the pH 8.2-8.7. Aquatic plants harbour a variety of fauna, including zooplankton such as Cladocera. The zooplankton samples were collected using a hand net (45 cm diameter) and a throw net (45 cm diameter) with muslin cloth (120 μ mesh size). The net was dragged through the macrophytes, slightly agitating the water column without stirring the mud. Samples

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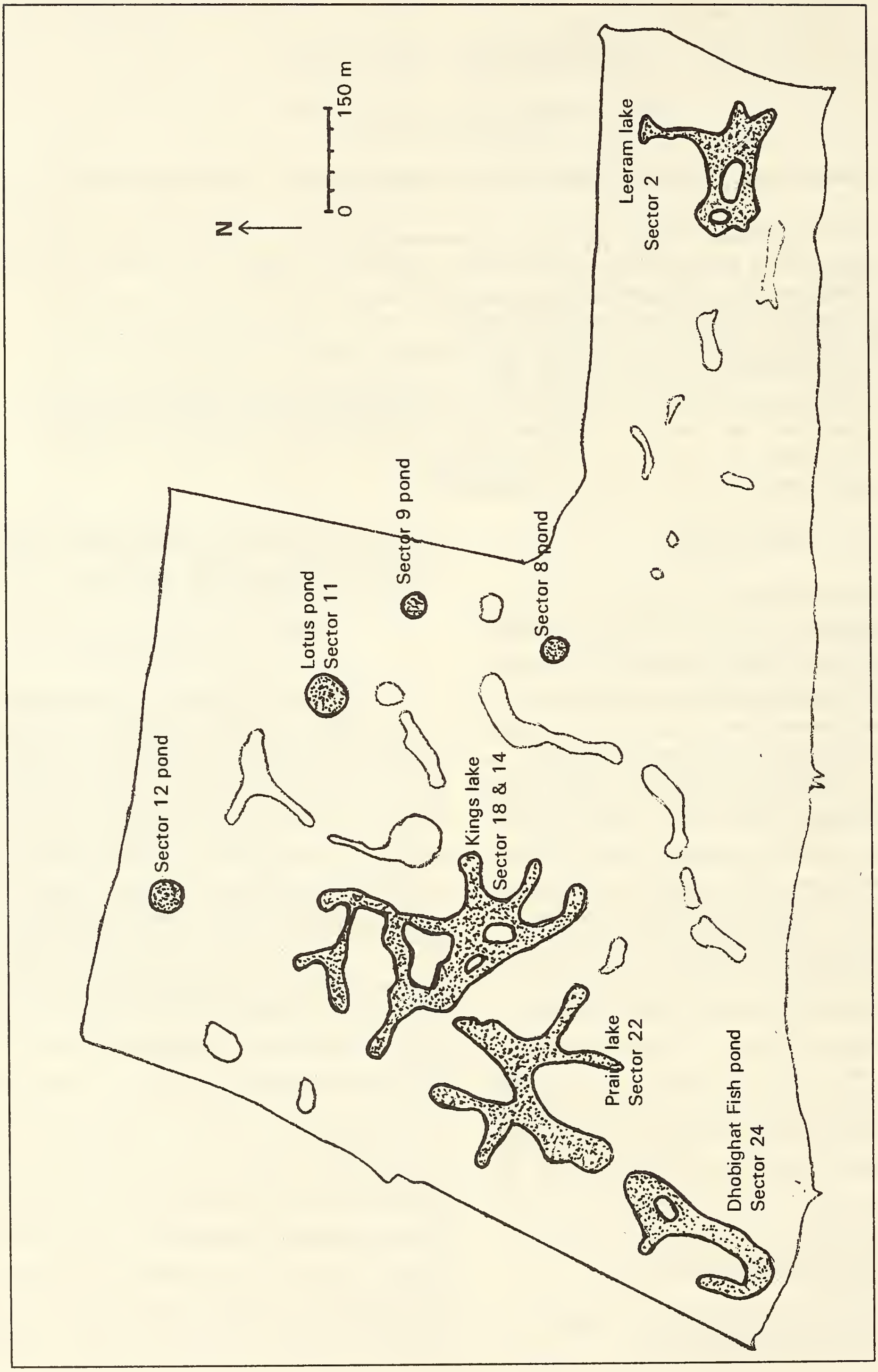

Fig. 1: Map of wetlands of Indian Botanical Garden showing the Cladocera collection spots

were preserved in the field and the Cladoceran species were identified as per Michael and Sharma (1988) using a monocular microscope in the laboratory.

Results

A total of 38 species of Cladocera belonging to 6 families and 21 genera were recorded in the present study (Table 1). Species such as *Pseudosida bidentata* Herrick, 1884, *Latonopsis australis* Sars, 1888, *Diaphanosoma volzi* Stingelin, 1905, *Diaphanosoma leuctenbergianum* Fischer, 1854, *Moina brachiata* (Jurine, 1820) *Bosmina longirostris* (O.F. Muller, 1776), *Pleuroxus similis* Vavra, 1900, *Alonella excisum* (Fischer, 1854), *Chydorus ventricosus* Daday, 1898, *Dadaya macrops* Daday, 1898, *Alona kwangsiensis* Chiang, 1963 and *Notalona globulosa* Daday, 1898 were found to occur only during one survey or in one wetland. The rest of the cladocerans were recorded during two surveys or in more than two wetlands. Among all the species, *Ceriodaphnia cornuta* Sars 1885 was found during all the three surveys in seven wetlands and *Diaphanosoma excisum* Sars 1885, *Macrothrix spinosa* King, 1853, *Chydorus sphaericus* (O.F. Muller, 1776) and *Alona karua* King, 1853 were recorded in all the three surveys in five wetlands. The following four species are new records for West Bengal:

Diaphanosoma volzi Stingelin, 1905

Material examined: Several females from Lotus pond (Sector 2, 27.ix.1994).

Female: Body size: 0.73 mm. Head rounded and small, eye relatively large. Carapace straight on ventral margin, duplicature forming a wide angle, posteroventral carnor rounded without denticles except for a long spine on the posterior margin. Postabdomen with three long and sharp pointed basal spines.

Remarks: New record to West Bengal. The material collected in the present study agrees with the description of *D. aspinosum* by Chiang (1956) from China and by Idris (1983) from Malaysia.

Diaphanosoma leuctenbergianum Fischer, 1854

Material examined: Several females from Dhobighat fish pond (Sector 24, 8.iii.1995).

Female: Body size: 1.20 mm. Head large, without rostrum. Eye large, situated close to the ventral margin. Carapace almost oblong in outline, posterior end abruptly truncate. Posterodorsal corner of valves almost ending in a right angle. Posteroventral corner with variable number of cilia followed by delicate cilia. Antenna reaching beyond the posterior margin of valve. Postabdomen narrow with fine setules. Claw with three basal spines, decreasing in size proximally.

Moina brachiata (Jurine,1820)

Material examined: Several females from Lotus pond (Sector 2, 27.ix.1994).

Female: Body size: 1.27 mm. Head large with medium sized eye situated closer to the dorsal margin than to the ventral side. Antennules long with sensory setae located at 1/3 the distance from head. Carapace almost round with distinct reticulations. Ventral margin of valves with long and short setae increasing in size posteriorly. Postabdomen large with long bidentate tooth and 13 feathered teeth. Claw with large pecten of 10 to 14 teeth.

Alona kwangsiensis Chiang, 1963

Material examined: Several females from Dhobighat Fish pond (Sector 24, 27.ix.1994).

Female: Body size: 0.45 mm. Shape oval in outline, maximum height slightly before middle from anterior end. Valves with a series of setae, district lines and polygonal patterns.

TABLE 1
OCCURRENCE OF CLADOCERANS OF INDIAN BOTANICAL GARDEN WETLANDS, HOWRAH

		WETLANDS							
Sl. No.	Name of the Species	N1	N2	N3	N4	N5	N6	N7	N8
ARTHROPODA CRUSTACEA CLADOCERA									
FAMILY: SIDIDAE									
1.	*Pseudosida bidentata*	-	-	-	-	-	-	-	1,2
2.	*Latonopsis australis*	-	-	-	-	-	-	-	1
3.	*Diaphanosoma excisum*	2	-	-	-	1,2,3	3	1,2	3
4.	*Diaphanosoma sarsi*	2	-	-	-	3	1,3	-	2
5.	*Diaphanosoma brachyurum*	-	-	-	-	-	-	1	2,3
6.	*Diaphanosoma volzi**	-	2	-	-	-	-	-	-
7.	*Diaphanosoma leuctenbergianum***	-	-	-	3	-	-	-	-
FAMILY: DAPHNIIDAE									
8.	*Simocephalus vetulus*	-	-	-	3	3	3	-	1,3
9.	*Simocephalus exspinosus*	-	1	-	-	-	1	-	-
10.	*Simocephalus serrulatus*	-	-	-	-	3	-	-	3
11.	*Ceriodaphnia cornuta*	1,2	-	2	1,2	2,3	2,3	1	3
12.	*Scapholeberis kingi*	-	-	-	-	-	-	1	3
FAMILY: MOINIDAE									
13.	*Moina micrura*	-	-	-	3	3	3	1	-
14.	*Moina brachiata**	-	2	-	-	-	-	-	-
FAMILY: MACROTHRICIDAE									
15.	*Macrothrix spinosa*	-	1	2	3	-	2	-	3
16.	*Macrothrix triserialis*	-	1	2	-	2	-	-	-
17.	*Ilyocryptus spinifer*	-	-	-	-	-	1	-	1
FAMILY: BOSMINIDAE									
18.	*Bosmina longirostris*	-	-	-	2	-	-	-	-
FAMILY: CHYODORIDAE									
Subfamily: Chydorinae									
19.	*Pleuroxus similes*	-	-	-	-	-	-	-	1
20.	*Alonella excisum*	-	-	-	-	-	-	-	3
21.	*Chydorus sphaericus*	-	1,2	-	2	2	3	-	1,2,3
22.	*Chydorus barroisi*	-	-	-	2	2	-	-	2
23.	*Chydorus reticulatus*	-	-	2	-	-	3	-	1,3
24.	*Chydorus ventricosus*	-	-	-	-	-	-	-	1
25.	*Dunhevedia crassa*	-	-	-	1,2, 3	2	1,3	-	1
26.	*Pseudochydorus globosus*	-	-	-	2	-	-	-	1
27.	*Camptocercus australis*	-	-	-	2,3	2	-	-	-
28.	*Dadaya macrops*	-	-	-	-	2	-	-	-

TABLE 1 (*contd*)
OCCURRENCE OF CLADOCERANS OF INDIAN BOTANICAL GARDEN WETLANDS, HOWRAH

		WETLANDS							
Sl. No.	Name of the Species	N1	N2	N3	N4	N5	N6	N7	N8
Subfamily: Aloninae									
29.	*Alona karua*	-	1	-	3	1,2	1,3	1	1,2,3
30.	*Alona pulchella*	-	-	-	2	-	-	1	3
31.	*Alona verrucosa*	-	-	-	2,3	2	-	-	1,3
32.	*Alona costata*	-	-	-	2	-	3	-	-
33.	*Alona kwangsiensis**	-	-	-	2	-	-	-	-
34.	*Alona davidi*	-	-	-	2	2	-	-	2
35.	*Alona rectangula*	-	-	-	3	2	-	-	3
36.	*Kurzia longirostris*	-	-	-	2	-	-	-	3
37.	*Oxyurella singalensis*	-	3	-	-	-	-	-	1,3
38.	*Notalona globulosa*	-	-	-	-	-	-	-	1

1 = April 1994, 2 = September 1994, 3 = March 1995 Surveys
N1 = Sector 12 Pond; N2 = Lotus Pond; N3 = Sector 9 Pond; N4 = Dhobighat Fish Pond; N5 = Prain lake; N6 = Leeram lake; N7 = Sector 8 Pond; N8 = Kings lake. (* New record to West Bengal; ** New record to India)

Ventral margin of valves with a series of setae, posteroventral corner rounded with five denticles attached marginally up to one third of the posterior region, followed by a row of small spines running the apex of rostrum. Postabdomen with distinct preanal and postanal corners and obtusely rounded dorsal margin. About 7-8 denticles attached submarginally followed by 3 groups of spines along the anal groove up to the preanal corner.

DISCUSSION

Out of the 38 species of Cladocera collected during the present study, four species namely *Diaphanosoma volzi*, *D. leuctenbergianum*, *Moina brachiata* and *Alona kwangsiensis* were reported for the first time from West Bengal while *D. leuctenbergianum* is a new record from India. Venkataraman (1993) recorded 57 species of Cladocera from West Bengal, which is more than half the number recorded in India (93 species, Michael and Sharma 1988).

In the present study, the occurrence of all the cladoceran species except *Diaphanosoma excisum*, *D. brachyurum*, *D. leuctenbergianum*, *Ceriodaphnia cornuta*, *Moina micrura*, *Bosmina longirostris* and *Ilyocryptus spinifer* with specific macrophytes suggests a mutual relationship. Even though a specific association between cladocerans and aquatic macrophytes is yet to be established, Synerholm (1974) observed that the diversity of Cladocera is affected by the presence or absence of these plants. Moreover, Whiteside and Hermsworth (1967), and Quade (1969) considered that the distribution of Cladocera is controlled by habitats and macrophytes rather than by lake types. However, Freyer (1968) has stressed the importance of the relationship between aquatic macrophytes and feeding habits, morphology and distribution of Cladocera. Such a trend was observed in the present study where species of *Simocephalus* were always found to attach themselves, by their anterodorsal carapace, to the leaf or stem of the aquatic plant *Hydrilla* sp. and filter the food particles present in the water. Likewise, many other species of chydorids were found to associate with a variety of aquatic macrophytes *Eichhornia crassipes*, *Pistia stratioties*, *Lemna* sp., *Nymphaea* sp., *Nelumbo* sp., *Ceratophyllum demersum*, *Vallisneria spiralis*, *Hydrilla* sp.,

Colocasia sp. etc. which are to be completely understood.

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SELECTION OF SUITABLE CENSUS METHOD FOR THE INDIAN SARUS CRANE *GRUS ANTIGONE ANTIGONE*[1]

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(*With one text-figure*)

Key words: *Grus antigone antigone*, census method, noon count, night roost, population density, paddy crop, summer months, reservoirs

An estimation of the population size of the Indian sarus crane *Grus antigone antigone* was done in the summer of 1997 and 1998. A total of 432 and 457 cranes were counted, in the 526 sq. km area of Kheda district, Gujarat, during hot hours (1200-1600 hrs) in 1997 and 1998 respectively. Night roost count at reservoirs (548) was higher than the day roost count. Results suggested that for accurate population estimation, the night roost count is better, but time and man power requirements can be a limitation. For a large scale census, the day roost count at reservoirs and their environs could be better.

INTRODUCTION

Estimation of avian population is the basic requirement to initiate any study leading to their conservation. Qualitative statements regarding status and distribution do not give a true picture of the population size, irrespective of the species studied. To decide conservation management strategies, it is necessary to estimate the actual population size at a given site at the right time. With a drastic reduction in its distribution range and a total of 12,000 individuals worldwide (Gole 1989, 1991), the Indian sarus crane *Grus antigone antigone* is now considered as a globally threatened species (Meine and Archibald 1996). Despite several limitations in the census method, attempts have been made to estimate the sarus crane population in Gujarat State (Vaishnav 1985) and its distribution range in India (Gole 1989). In Kheda district, the sarus crane density on a fixed route had been attempted (Parasharya *et al.* 1996) along with population estimation. Here we have attempted to estimate the sarus crane population in Matar tehsil of Kheda district to supplement the above study during summer in two successive years.

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We attempted to determine the total population using two different methods. This paper describes the merits and demerits of both the methods selected for determining the sarus crane population and density.

MATERIAL AND METHODS

The census was done during the summer months April, May and June 1997 and May 1998. Cranes encountered along the road and in and around reservoirs were counted within the four hour period of 1200-1600 hours (hot hours) in one day. If an area was left uncovered during the stipulated time period, it was completed on the next day. The cranes concentrated chiefly around five major reservoirs. Hence, the maximum crane count around any of these reservoirs, in a particular month, was taken into consideration during the census of 1997. At the same time, care was taken to ensure that the crane population in the adjacent area was counted as a separate population. Cranes sighted within 800 m on either side of the road were also counted. The presence and growth stage of paddy crops around the census area were noted to understand the crane distribution pattern. During 1998, counts were done only on 24-25 May.

Night roost counts were attempted at 16 reservoirs from May 17-24, 1998. Unlike the

noon count, in which one person could count cranes on several reservoirs in a four hour period, it took one person to estimate the roosting cranes at a particular reservoir in one night. Thus, the three individuals involved could survey only three reservoirs in a single day. All the cranes present in the reservoir and the ones arriving were counted till it was totally dark. The sun set at 1912-1916 hours during the count period.

Study Area

The study was conducted in a 526.03 sq. km area spread over Matar, Khambhat and Petlad tehsil of Kheda district, Gujarat. Major reservoirs, at which the study was conducted, along with the main roads, are shown in Fig. 1. The study area has the benefit of well established branching canals terminating in reservoirs. The landscape is plain, low lying and suitable for paddy crop (*Oryza sativa*) cultivation during monsoon due to irrigation facilities. During the southwest monsoon (July to September), the whole area gets flooded and remains so till late September. In the summer (April to June), the reservoirs retain some water, at least at miniumum level. Depending on local conditions, paddy crop is grown in the command area of some reservoirs even in summer. The temperature reaches 45.6 °C, particularly in May.

Results

Population estimation during hot hours in summer: The sarus crane population in the study area (526.03 sq. km) in 1997 was 432, while in 1998 it was 457 (Table 1), and had a density of 0.82 /sq. km to 0.87 /sq. km cranes respectively. The difference in the numbers sighted between the two years was negligible. Moreover, this was the minimum population estimated, as only the actually seen cranes were counted.

Table 1
POPULATION ESTIMATION OF SARUS CRANE DURING NOON HOURS OF SUMMER MONTHS IN KHEDA DISTRICT, GUJARAT

Sites	No. of cranes observed 1997	1998
1. Bhanderaj (R)	76	79
Surrounding area	3	4
2. Narda (R)	135	0
Surrounding area	17	21
3. Gobrapura (R)	0	0
Surrounding area	40	138
4. Daloli (R)	65	105
Surrounding area	6	8
5. Traj (R)	44	0
Surrounding area	9	1
6. Pariej (R)	0	0
Surrounding area	2	6
7. Kanewal (R)	0	0
Surrounding area	23	15
8. Others (R)	12	80
Total	432	457

During both years, the crane number was highest in Narda-Gobrapura and its surrounding complex, proving it to be an important area (Table 1). Bhanderaj and Daloli also supported a high number of cranes. Though Kanewal and Pariej were the largest reservoirs, the number of cranes present here were insignificant, as both the reservoirs have a very great water depth and lack suitable roosting sites. They are also subject to continuous human interference, especially disturbance from fishing.

The cranes which concentrated at the Narda reservoir and its environs in 1997 shifted to Gobrapura in 1998. Similarly, the cranes at Traj and its environs shifted to Machhial. Both the shifts were within 5-6 km, and were probably due to changes in the water level of the reservoir and the paddy crops around it. The crane count, at the five reservoirs, was fairly high and constant during the study period.

All these reservoirs are situated within a range of 5-15 km from each other, but still hold a distinct population, suggesting that sarus cranes are highly sedentary and restricted in their activity around a particular reservoir.

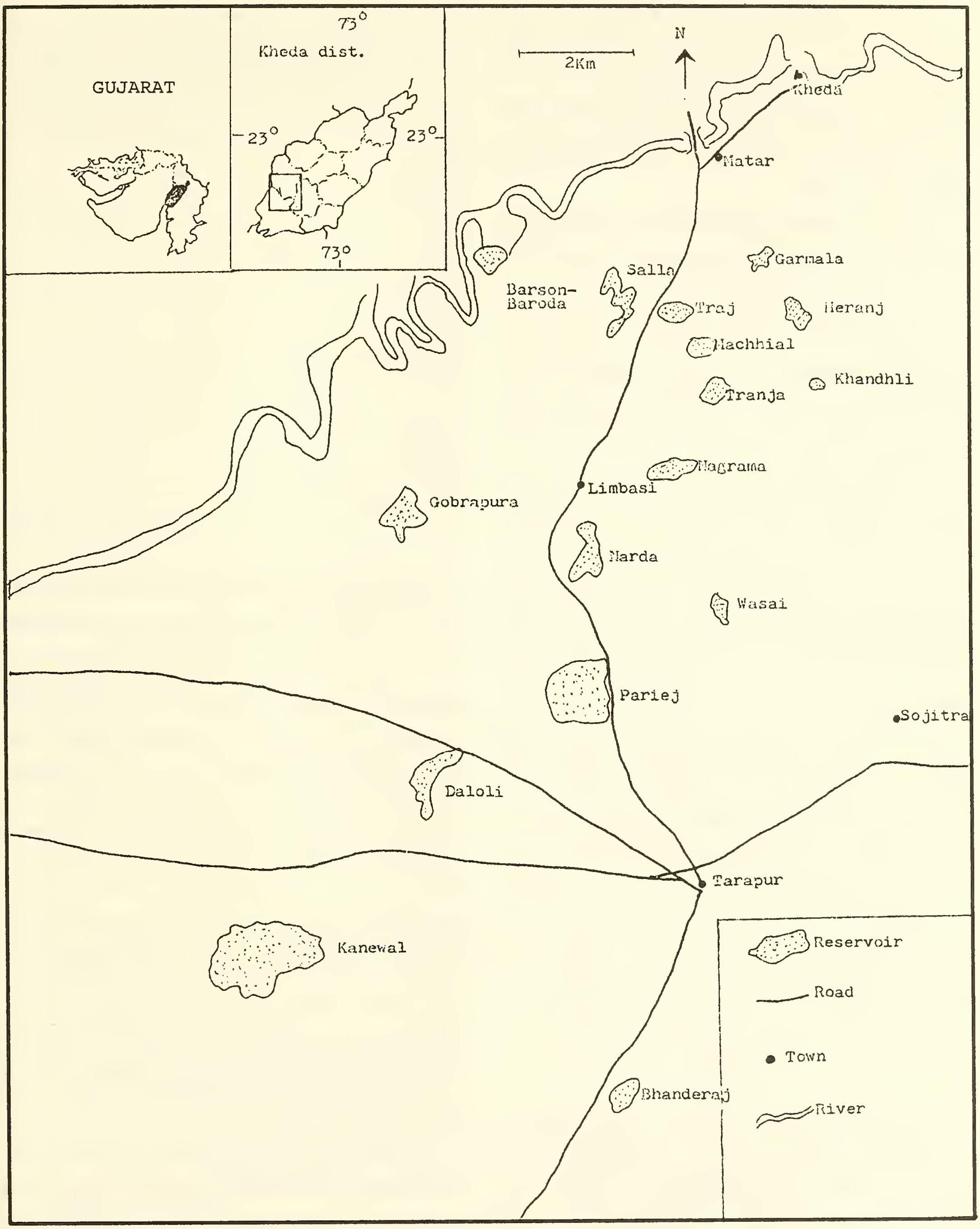

Fig. 1: Major reservoirs and roads in the study area

In the summer, due to heat and stress, the cranes concentrated around the reservoirs in large flocks, which aided the census. However, the paddy crops growing around the reservoirs also provided a suitable protected habitat from the heat, which was evident from the count in the surrounding area.

Population estimation during night roosting in summer: As it was a dry period, all the cranes converged to the reservoirs for roosting. Sixteen reservoirs spread over the study area were monitored to count the roosting sarus population, hence no flock was missed from the total estimate. A total of 548 sarus crane were counted, giving a density of 1.04 /sq. km during a night roost count.

About 65% of the cranes concentrated chiefly around 4 major reservoirs, the Daloli, Gobrapura, Narda and Machhial (Table 2). The area important for day roosting, was also found significant for night roosting. Another important site was Bhanderaj, which had 24% of the sarus cranes at night. 11% were distributed in 8 small reservoirs.

Three reservoirs, though they had sufficient water, were not used by the cranes. The sarus cranes numbers at a particular reservoir were determined by its water level and suitable, safe roosting sites. At Barson-Baroda the cranes roosted in the shallow waters of the river basin. It was the only site of the riverine area that we examined for the night roost. The number of cranes estimated during the night roost was 16% higher than the count during the day roost.

TABLE 2
POPULATION ESTIMATION OF ROOSTING SARUS CRANE, DURING SUMMER, IN KHEDA DISTRICT, GUJARAT

Site	Crane number
Bhanderaj	133
Narda	51
Gobrapura	60
Daloli	152
Traj	00
Pariej	02
Kanewal	04
Tranja	02
Salla	12
Naghrama	04
Heranj	00
Khandhli	00
Garmala	02
Machhial	92
Vasai	09
Barson-Baroda	25
Total	548

DISCUSSION

During summer, the water was available only in the reservoir or in the paddy crops growing around the reservoirs. To avoid heat stress, the cranes flocked in the reservoirs or in the paddy crop, enabling an almost accurate population estimation. To avoid the heat stress of summer, the sarus cranes are known to flock in the wetlands (Ramachandran and Vijayan 1994, Mukherjee *et al.* 1999, in press).

In summer, the cranes move far off for foraging during the morning and evening hours, but they returned to the reservoirs from 1200 hours onwards (Mukherjee *et al.* 1999). Once at the reservoir, the cranes did not show any movement for four hours and hence, the chances of count duplication were negligible. Four hours are sufficient to travel across the study area to estimate the population in the reservoir and along the route. Two persons with a vehicle needed two days to complete the count in the 526.03 sq. km area. Hence, sarus crane census during hot hours (1200-1600 hours) in the summer is ideal. Limited man power and time frame placed restrictions on the size of the area which could be surveyed.

The cranes utilised the summer paddy crops during the hot hours, both as foraging and roosting ground leading to a dispersed distribution, which subsequently caused underestimation of the population size. During

the summer of 1997, paddy was grown around most of the reservoirs making accurate counts difficult. However, in 1998, the cultivated area was limited, hence counting was easy.

In 1998, along with the day roost counts, night roost counts were made to overcome this drawback. For accurate population estimate, we made night roost counts in all the 16 reservoirs. The crane count during night roost was certainly higher than the day roost count. However, the one person to one reservoir ratio is time consuming and requires more man power. Our night roost counts could be accurate, as we were familiar with the study site and with the direction of the arriving cranes. Night roost counts can possibly be difficult in an unknown area, but in the present case, they were more accurate than the day roost count.

There was a difference of only 91 cranes in the counts by two methods. This indicates that the sarus is sedentary, does not show frequent movements and prefers the same area for day and night roosting. At least in the summer, cranes hardly dispersed 5-6 km from the reservoir. They also had an affinity for the water bodies for roosting. The same was seen around Bhanderaj, the only reservoir which ultimately attracted cranes from all over the area. Thus, the study highlighted the importance of these wetlands for the protection and conservation of the sarus crane.

It is worth noting that in the 526.03 sq. km of the study area, paddy was the only crop grown during monsoon. It was also grown in patches around reservoirs during summer. All the wetlands retained some level of water even in summer. However, only a few reservoirs were used by the cranes for roosting. Crane distribution was patchy, indicating that the presence of water in the reservoirs or in the paddy crop around reservoir are not the only factors responsible for the crane abundance / distribution. Gole (1989) had developed a formula to estimate crane population based on crane density derived through road transect and total wetland area separately. On the contrary, our study revealed that even though several wetlands existed, some were not utilised by cranes. Therefore, the earlier report by Gole (1989) may represent an inaccurate count. Recently, Mukherjee *et al.* (in press) had established a positive correlation between sarus crane abundance and percentage land under irrigated paddy crop, as well as visibility index / openness of the habitat. However, we found that in summer, factors like flocking, availability of paddy crop and time of the day influenced the crane numbers counted.

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NEW DESCRIPTIONS

A NEW SPECIES OF THE GENUS *OPIUS* WESMAEL (HYMENOPTERA: BRACONIDAE) FROM INDIA[1]

S.M. KURHADE[2] AND P.K. NIKAM[3]

(*With three text-figures*)

Key words: Hymenoptera, Braconidae, Opiinae, *Opius* (*Utetes*) sp. nov.

Opius (*Utetus*) *fischeri* sp. nov. is described and illustrated.

INTRODUCTION

Wesmael (1835) erected the genus *Opius* (Subfamily: Opiinae) with the type species *Opius pallipes* Wesmael, which was designated as the type by Muesebeck and Walkley (1951). Fischer (1964, 1965) revised the genus entirely. The taxonomy of this genus was also attempted by Fischer (1971, 1972) and Marsh (1974).

Fischer (1988) divided *Opius* into three subgenera (namely *Aulonotus* Ashmead, *Utetes* Foerster and *Gastrosema* Fischer), and also provided a key to the groups and species of *Utetes* for the Indo-Australian and Ethiopean regions.

In the present work, *Opius* (*Utetes*) *fischeri* sp. nov. is described on the material collected in India: Maharashtra: Ahmednagar.

The new taxon runs close to *Opius* (*Utetes*) *buloloensis* Fischer and has been included in the key to the species of *alutaceus* group of *Opius* (*Utetes*) by Fischer (1988). This key, which is originally in German, has been provided here in English.

Types are deposited in the Entomological collection of the Department of Zoology, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad.

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KEY TO THE SPECIES OF SUBGENUS *UTETES* FOERSTER GROUP *O. ALUTACEUS* BY FISCHER (1988)

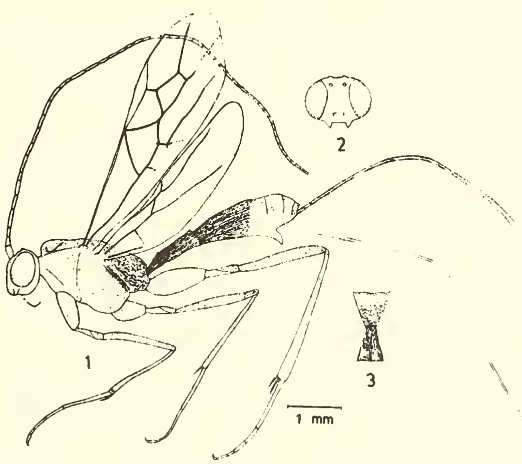
1. Mesoscutum mainly sparsely pubescent, lateral lobe appears almost bare 2
— Mesoscutum bare, except along the notauli, pubescent 10
2. Clypeus 3x as broad as long; ovipositor sheath of female as long as abdomen, the projecting part of the ovipositor longer than half the abdomen, 3.5 mm, South Africa .... *O. trichomaticus* Fischer
— Clypeus almost 1.7x as broad as long; ovipositor sheath of female almost as long as the first tergite 3
3. Head and face with small hairs, hair punctures not recognisable, r3 2x as long as r2 4
— Head and face with dense and small punctures and small hairs; r3 1.5-1.66x as long as r2 9
4. First tergite 1.2x as long as wide basally, 2.3 mm, New Guinea .... *O. gregori* Fischer
— First tergite 1.5x as long as broad or longer ... 5
5. Head, thorax and abdomen yellowish-red, 2.7 mm, New Guinea .... *O. buloloensis* Fischer
— Head, thorax and abdomen differently coloured 6
6. Body yellowish-brown, 5.7 mm, India: Maharashtra .... *O. fischeri* sp. nov.
— Body completely dark or thoracic divisions black and abdominal divisions white 7
7. r2 1.5x as long as cubital; first tergite 1.5x as long as broad, basally, longitudinally striate as a rule, 2.3 mm New Guinea .... *O. gregoriformis* Fischer
— r2 1.7x as long as cubital or longer; first tergite 2x as long as broad, basally, longitudinally striate or not 8

8. r2 2.2x as long as cubital; head and thorax completely black, legs yellow; first tergite black, rest brown, 2.5 mm, New Guinea .... *O. neogregori* Fischer
— r2 1.7x as long cubital; head and anterior part of thorax red; legs black and anterior half of the abdomen white, 2.0 mm, New Guinea .... *O. albipus* Fischer
9. Thorax 1.5x as long as high; first tergite 1.5x as long as broad basally, 3.0 mm, Philippines .... *O. pilosidorsum* Fischer
— Thorax 1.3x as long as high; first tergite as long as wide basally, 2.1 mm, New Guinea .... *O. arcithorax* Fischer
10. Second tergite rugose or striated 11
— Second tergite smooth 13
11. r2 arising from behind the middle of the stigma, 3.5 mm, Zaire .... *O. prophylactius* Fischer
— r2 arising from before the middle of the stigma 12
12. r2 about one third longer than cubital, second tergite striate; ovipositor projects out slightly, 2.6 mm, New Hebriden ..... *O. cheesmanae* Fischer
— r2 almost 2x as long as cubital; ovipositor sheath about one third of the body length, 2.1 mm, Madagascar .... *O. alutaceus* Granger
13. Thorax 1.7x as long as high, 3.4 mm, S. Africa .... *O. extendithorax* Fischer
— Thorax 1.25-1.33x as long as high 14
14. r2 2 x as long as cubital, 3.8 mm, Philippines . ... *O. infernalis* Fischer
— r2 almost 1.5x as long as cubital 15
15. Mesoscutum strongly continuously punctate; notauli distinct; middle lobe separated; thorax 1.25x as wide as long, 3.4 mm, Taiwan .... cf. *O. fulvifacies* Fischer
— Mesoscutum punctate; notauli with small punctures; mesoscutum as long as broad, 1.9 mm, Madagascar .... *O. mediorufus* Granger

Opius* (*Utetes*) *fischeri sp. nov. (Figs 1-3)

Female: Length 5.7 mm. (Fig. 1). Head (Fig. 2) 0.5x as long as wide; vertex smooth, sparsely pubescent; ocelli in triangle, with broad base, on a black oblong spot; ocello-ocular distance same as inter-ocellar distance; frons narrow, smooth, pubescent; face 0.7x as long as wide, convex, depressed medially, shiny, moderately punctate, pubescent; clypeus 2x as wide as long, convex, shiny, moderately punctate, pubescent; clypeal fovea distinct; malar space 0.6x width of mandible; mandible 1.6x as long as wide, bidentate; eye 1.5x as long as wide, bare; interorbital distance 0.8x as long as height of the eye; antenna 2 + 47 segmented; scape 1.7x as long as wide, smooth, weakly punctate, pubescent; pedicel 0.8x as long as wide, smooth, weakly punctate, pubescent; penultimate segment 1.5x as long as wide; terminal segment 2.5x as long as wide; first flagellar segment 7.7x as long as wide; second flagellar segment 0.7x as long as first; occiput not margined.

Thorax: 2.3x as long as wide; pronotum shiny, very weakly punctate, pubescent; mesoscutum shiny, convex, very weakly, shallowly punctate, pubescent; notauli distinct, transversely crenulated; scutellum shiny, convex, weakly punctate, pubescent, apex elevated mid-dorsally; propleurum, smooth, shiny, very weakly punctate; mesopleurum smooth, shiny, closely punctate, pubescent; mesopleural suture distinct; mesopleurum rugosely, closely punctate,



Figs. 1-3: *Opius (Utetes) fischeri*, sp. nov., Female, 1. Lateral view; 2. Head (frontal view); 3. Propodeum and first abdominal tergite.

pubescent; propodeum (Fig. 3) irregularly reticulate, basal 0.4 rugose, pubescent, spiracle rounded. Hind leg coxa 2.7x as long as wide, sparsely punctate, pubescent; trochanter I 1.4x as long as wide, trochanter II 3x as long as wide; femur 3.8x as long as wide, slender, long, closely punctate, pubescent; tibia 17x as long as wide, closely punctate, pubescent; tibial spur 0.25x as long as basitarsus; basitarsus 0.4x as long as tibia; claw bifid. Fore wing 3.3x as long as broad; stigma 5.7x as long as wide; metacarpus 1.5x as long as stigma; first abscissa of radius 0.5x as long as second; apical abscissa of radius 5x as long as first; second cubital cell with four unequal sides; first intercubitus 2.2x as long as second intercubitus; costa 2.4x as long as stigma; medius 1.7x as long as basal; discoideus 0.6x as long as medius; nervulus slightly inclivous, distad, 1.2x as long as width of stigma; subdiscoideus 0.4x as long as submedius; brachius 3.1x as long as nervulus; margin with fine bristles; hind wing 5x as long as broad; subcostella 1.2x as long as radiella; mediella 6.7x as long as basella; nervellus slightly inclivous, 2.9x as long as submediella; cubitella 1.1x as long as mediella; margin with fine bristles.

Abdomen: 4.5x as long as wide; first tergite 2x as long as apical width, strigose, weakly punctate, pubescent; second tergite as long as apical width, strigose, pubescent; third tergite 0.9x as long as wide, strigose, weakly punctate, pubescent; remaining tergites smooth, moderately punctate, pubescent; ovipositor 5.7 mm.; ovipositor sheath as long as ovipositor, with stiff bristles throughout the length.

Yellowish-brown. One oblong spot on vertex, stigma, veins, tips of mandibles and ovipositor blackish-brown; first tergite towards apical region, fourth, fifth, sixth and seventh tergites on mid-dorsal side and ovipositor sheath reddish-brown.

Male: Unknown.

Host: Unknown.

Holotype: Female: INDIA: Maharashtra: Ahmednagar, 5.x.1989. On wing, Coll. S.M. Kurhade; antenna, legs and wings mounted on slides and labelled as above.

Paratypes: 3 females, data same as holotype.

Etymology: The species has been named *fischeri* in honour of Dr. Maximillian Fischer, a well known taxonomist of Braconidae.

Comments: In accordance with the key to the Indo-Australian and Ethiopian species of the *Opius* (*Utetes*) *alutaceus* group by Fischer (1988) the new species, *Opius* (*Utetes*) *fischeri* resembles *Opius* (*Utetes*) *buloloensis* Fischer (1988) in the characters: (i) mesoscutum pubescent, (ii) notauli distinct, (iii) ovipositor long, (iv) face pubescent and (v) first tergite longer than apical width; but it differs from it in the following characters: (i) body 5.7 mm (in *buloloensis* body 2.7 mm), (ii) head 0.5x as long as wide, (in *buloloensis* 0.55x as long as wide), (iii) clypeus 2x as wide as long (in *buloloensis* 1.4x as wide as long), (iv) antenna 2 + 47 segmented, (v) propodeum irregularly reticulate, (vi) ovipositor long and (vii) body yellowish-brown (in *buloloensis* body yellowish-red).

ACKNOWLEDGEMENTS

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ACHLYA DAYALI, A NEW WATER MOULD FROM THE RIVER MUTHA[1]

R.V. Gandhe, Kanchanganga Gandhe and M.J. Desale[2]

(*With five text-figures*)

Key words: new species, *Achlya dayali*, comparison

Achlya dayali, a new species of *Achlya*, has been isolated from the River Mutha and compared with its allied species *A. racemosa*.

Introduction

Aquatic fungi were isolated from the Rivers Mula and Mutha. A total of 11 genera, and 24 species were isolated from the different established sampling stations on the rivers. Amongst all the genera, the genus *Achlya* with its 13 species was dominant and isolated frequently from all the stations. *A. dayali* is described here as a new species, it broadly resembles *A. racemosa* Hildebrand (Coker 1923, Johnson 1956), but differs in developing short or long stalked oogonia and only one or two centric oospores. (Coker 1923; Johnson 1956; Sparrow 1960, 1968, 1973; Dayal and Thakurji 1969; Howard 1971; Dick 1973; Dayal and Usha Kiran 1988) The new species described here was isolated only from the Vitthalwadi sampling station, on the Mutha, in July.

Material and Methods

Five sampling stations were established on River Mutha for regular collection of water samples every fortnight. These were Khadakwasla, Vitthalwadi, Garware College, Bal Gandharva bridge and Sangam bridge. Zoosporic fungi were isolated from these samples by baiting (Butler 1907). Mixed cultures were purified by the hyphal tip technique. Temperature of the water samples was measured directly, whereas pH and DO were measured as per standard procedures (APHA 1992).

Achlya dayali sp. nov.
(Figs 1-5)

Growth in culture moderately dense, hyaline, developing into a colony of 1 cm diameter within a week. Hyphae stout at the base, 85.2 µm thick, tapering gradually at the tips, often sparingly branched.

Zoosporangia abundant, elongated, cylindrical, rounded or tapering at the tips, almost the same size as the hyphae, rarely a little larger, 28.4 µm to 48.0 µm in diameter, twisted like a cork screw, often more sporangia developed very closely below the first one. Zoospores 9.3 µm in diameter, forming an irregular mass, which slowly enlarges; spores released singly or in groups. Gemmae few, mostly terminal, slightly swollen.

Oogonia abundant, scattered all over the culture, 31.2 µm to 46.8 µm in diameter, often racemosely developed, on long slender stalks, rarely on short stalks of the main hyphae, spherical, sometimes curved; oogonial wall smooth or inconspicuously pitted at the contact of antheridium. Eggs spherical, one or two per oogonium, 18.7 µm to 28.7 µm in diameter, centric, majority of oogonia with a single egg occupying almost entire space.

Antheridial branches often androgynous, long, occasionally short, developed from the long stalks of oogonia, may be coiled, very often single

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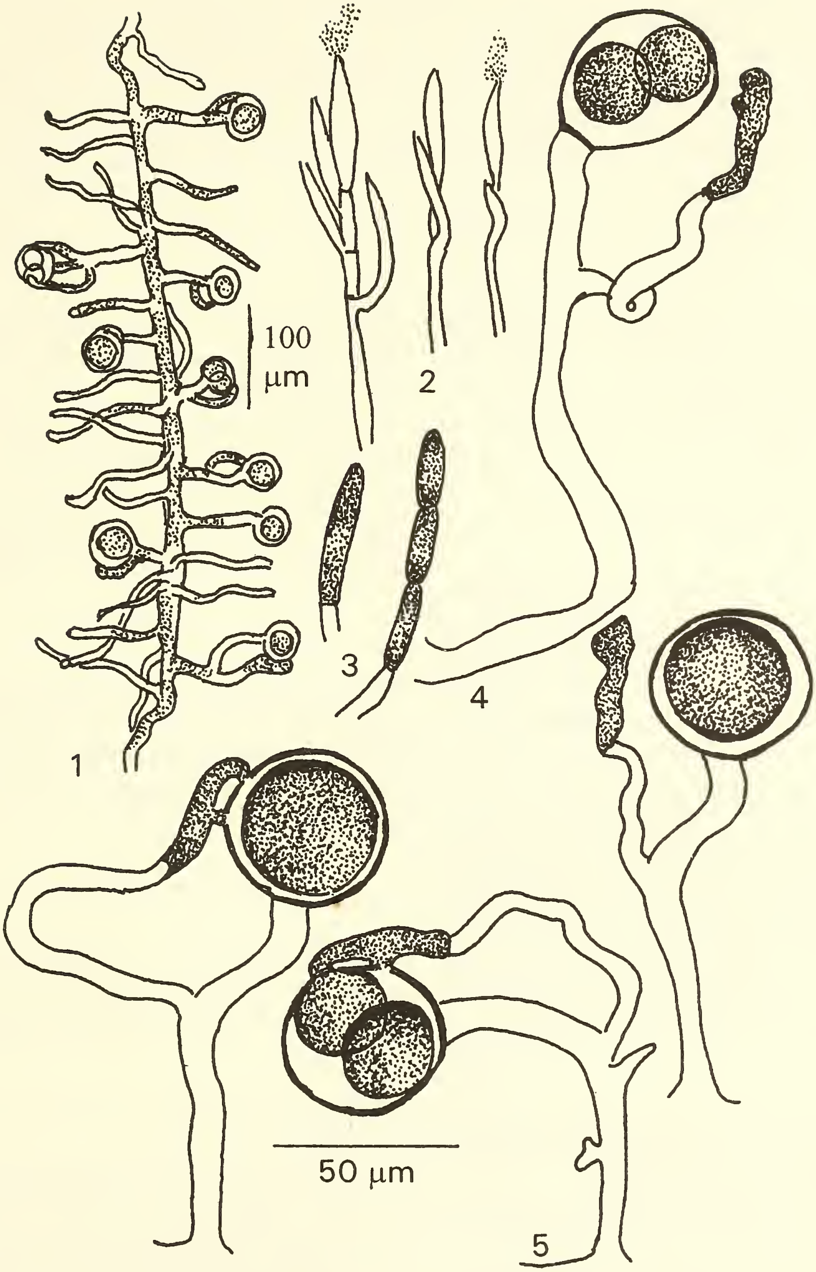

Figs 1-5: *Achlya dayali* sp. nov.:
1. Thallus showing oogonia with monoclinous androgynous antheridia; 2. Development of zoosporangia (note twisted sporangia); 3. Segmented gemmae; 4. Long stalked oogonia with androgynous antheridia; 5. Oogonia with curved stalk (note antheridial cell projections and centric oospores).

TABLE 1
COMPARISON OF CHARACTERISTICS OF *ACHLYA RACEMOSA* AND *ACHLYA DAYALI*

	Hyphae	Sporangia	Zoospores	Oogonia	Oospore
A. racemosa Hildebrand	30-90 µm, usually 25-36 µm	200-900 * 15-45 µm, usually 300-400 * 25-35 µm	8-12 µm	30-110, usually 40-80	15-38 µm, usually 23-29; 1-10 in number, usually 2-6
A. dayali sp. nov.	85.2 µm	28.4-48.0 µm	9.3 µm	31.2-46.8 µm	18.7-28.7 µm; 1 or 2 in number

antheridium about the oogonium. Conspicuous fertilization tube may be present. No epigynous antheridia were observed.

Isolated from Mutha river, July 1995, Pune, Maharashtra, India.

LATIN DIAGNOSIS

Mycellis in semmine opium tenuibus, hyphis ramosis porrectis usque ad 1.0 cm in diametrum. Hyphis primarilis in basi 85.2 µm diam. Sporangiis copiosis, attenatis sine cylindractis ad basim saepicus lateroribus, 28.4 µm to 48.0 µm in diametrum, basi proliferantibus, apice dehiscentibus et in sphaerula dispositis. Gemmae pancis, variiae, natu majoriibus valde variae. Oogoniis copiosis, globosis, autellipticis natis ex primarilis hyphis in ramulis lateralibus longis curvis aut raro rectis, oogoniis ipsis 31.2 µm to 46.8 µm in diametrum tunica crassa non-punctata, oosporiis numero 1-2, globosis, 18.7 µm to 28.7 µm in diametrum, guttulis olivaceosis centrice dispositis; tunica crassa, hyalina. Antherididiis pancis diclinibus and androgenibus.

Hab ad terram humosam in rivi Mutha, July 1995, Pune, Maharashtra, India.

Etymology: The species is named in honour of Prof. R. Dayal who has published a monograph on zoosporic fungi of India.

DISCUSSION

Achlya dayali, described here as a new species, showed important and major differences from its closest allied species *A. racemosa*. It is described as a new species on the basis of the differences given in Table 1.

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A NEW GENUS *MANGINA* ALONG WITH THE TAXONOMY OF *ARGINA* HÜBNER (ARCTIINAE: ARCTIIDAE: LEPIDOPTERA) [1]

AMRITPAL S. KALEKA AND JAGBIR S. KIRTI[2]

(*With eleven text-figures*)

Key words: *Argina*, *Mangina*, genitalia, congeneric

The taxonomy of genus *Argina* Hübner has been revised by incorporating the male and female genital features of the type species *astrea* (Drury). Another Indian species *argus* Kollar, earlier described under *Argina* Hübner, has been found non-congeneric on the basis of its genital structures. A new genus *Mangina* has, therefore, been proposed for *argus* Kollar. The new genus is closely allied to *Argina* Hübner.

INTRODUCTION

According to Hampson's key (Hampson 1894), two species namely *cribraria* Clerck and *argus* Kollar are referred to genus *Argina* Hübner. The specific status of these two species was confirmed from the Zoological Survey of India, Kolkata, Forest Research Institute, Dehra Dun and Natural History Museum, London. Watson *et al.* (1980) observed that *Phalaena astrea* Drury is the oldest of junior subjective synonyms of *Phalaena cribraria* Clerck, and made it available as a subjective replacement name for the former species i.e. *Argina cribraria* Clerck which is also the type species of *Argina* Hübner. A critical study of the structures of male and female genitalia reveal that the species *argus* Kollar is not congeneric with the type species *astrea* (Drury) of genus *Argina* Hübner. Thus, the status of this species is not stable under genus *Argina*. Accordingly, a new genus *Mangina* has been proposed for this species, and the justification has been given.

TAXONOMIC DESCRIPTIONS

Genus *Argina* Hübner

Hübner, 1818, Verz. bekr. sch., 1818 : 167.

Type Species: *Argina astrea* (Drury).

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Distribution: Throughout India, Africa, Mauritius, China, Sri Lanka, Myanmar, New Guinea and Australia.

Diagnosis: Labial palpus upturned, extending well beyond lower level of frons, third joint short. Antenna ciliated in both sexes. Forewing with veins R_2 and R_3 from areole formed by anastomosis of R_3 and R_4; M_1 arising from upper angle of cell; veins M_2, M_3 and Cu_1 from close to lower angle of cell. Hindwing with vein $Sc + R_1$ originating from before middle of cell; M_1 from upper angle of cell; M_2, M_3 and Cu_1 from or near the lower angle of cell; in male, hindwing with a fold on inner margin containing a glandular patch near base with a tuft of long hair beyond it, tornus produced. Hind tibia with a pair of terminal spurs. Male genitalia with uncus moderately long, tip with an acute spine; fenestrula prominent; tegumen with both its arms wide; almost of same length as vinculum; saccus more or less developed; valva long; sacculus well marked; costa slightly defined; valvula curved, extending well above cucullus; cucullus flap-like, with longitudinal rows of sclerotized lines and large number of denticles; juxta with two parallel sclerotized flaps, joined together at tip, aedeagus with its anterior end balloon-shaped; vesica with 3-4 patches of denticles and spines representing cornuti. Female genitalia with corpus bursae large, membranous; three rounded signa present; ductus bursae short and broad, heavily sclerotized: papilla analis triangular, setose with short and long setae.

Argina astrea (Drury)
(Figs 1-5)

Phalaena astrea Drury, 1773, Ill. Exot. Ins. *2*: 11; Hmpsn., 1894, Moths Ind. *2*: 51; *Phalaena cribraria* Clerck, 1764, Icon. Inst. rariorum, *2*: 54; *Argina guttata* Rambur, 1859, Lep. And. *2*: 229; *Argina notata* Butler, 1877, Trans. Ent. Soc. 1877 : 365.

Material examined: Himachal Pradesh: Solan, 2.vi.1994, 1 ♂, 1 ♀; Punjab: 7.ix.1991, 1 ♂, 2 ♀♀; 1.x.1991, 3 ♂♂. Uttar Pradesh: Dehra Dun, 13.x.1991, 1 ♂, 1 ♀; Kempty Falls, 20.ix.1995, 1 ♂; West Bengal: Kurseong, 28.iv.1995, 1 ♂, 1 ♀; 29.iv.1995, 6 ♂♂. Coll. Amritpal Singh.

Distribution: Recorded throughout India, Sri Lanka, Myanmar, China, Mauritius, New Guinea.

Remarks: Holloway (1988) described and illustrated *Argina astrea* (Drury) in detail, including its genital structures and synonymized *cribraria* Clerck under it. Thus, the description of the species is omitted. However, the male and female genitalia have been illustrated here for comparison with the type species *argus* (Kollar) of the new genus *Mangina*.

Mangina gen. nov.

Type Species: *Argina argus* Kollar.

Distribution: Throughout India, Sri Lanka and Myanmar.

Diagnosis: Labial palpus upturned, surpassing lower level of frons. Antenna simple, ciliated in both sexes. Forewing rather short and broad; veins R_2 from short areole formed by anastomosis of R_3 and R_4; R_5 from common stalk of R_{3+4}; M_1 arising from upper angle; M_2 from above lower angle; Cu_1 before lower angle of cell; Cu_2 beyond middle of cell. Hindwing with vein $Sc + R_1$ originating before middle of cell; Rs and M_1 from upper angle of cell; M_2 and M_3 from lower angle of cell; Cu_1 well before lower angle of cell; in male, tornus produced and glandular patch near base, with a tuft of long hair beyond it. Hind tibia with a terminal pair of minute spurs. Male genitalia with uncus long and curved, gradually narrowing towards tip, sickle-shaped; fenestrula rounded; tegumen well developed, inverted V-shaped, almost double length of vinculum; vinculum small and narrow, well sclerotized; saccus narrow, knob-like; valva long and narrow; sacculus broad and distinct; costa narrow; cucullus and valvula not marked, distal end bifurcated with paired spines on each tip: ampulla well sclerotized, broad at base, tip sharply pointed, setose, inner arm extends into fused cucullus and valvula. Aedeagus long and narrow, anterior end broad, both of its walls equally sclerotized, distal end with a sclerotized patch; vesica armed with a large number of fine denticles. Female genitalia with corpus bursae large, oval and membranous, a pair of semicircular signa present; ductus bursae broad, highly sclerotized; accessory sac present; anterior apophyses shorter than posterior apophyses, apices rounded and narrow; papilla analis broad and rounded, setose with micro and macro setae.

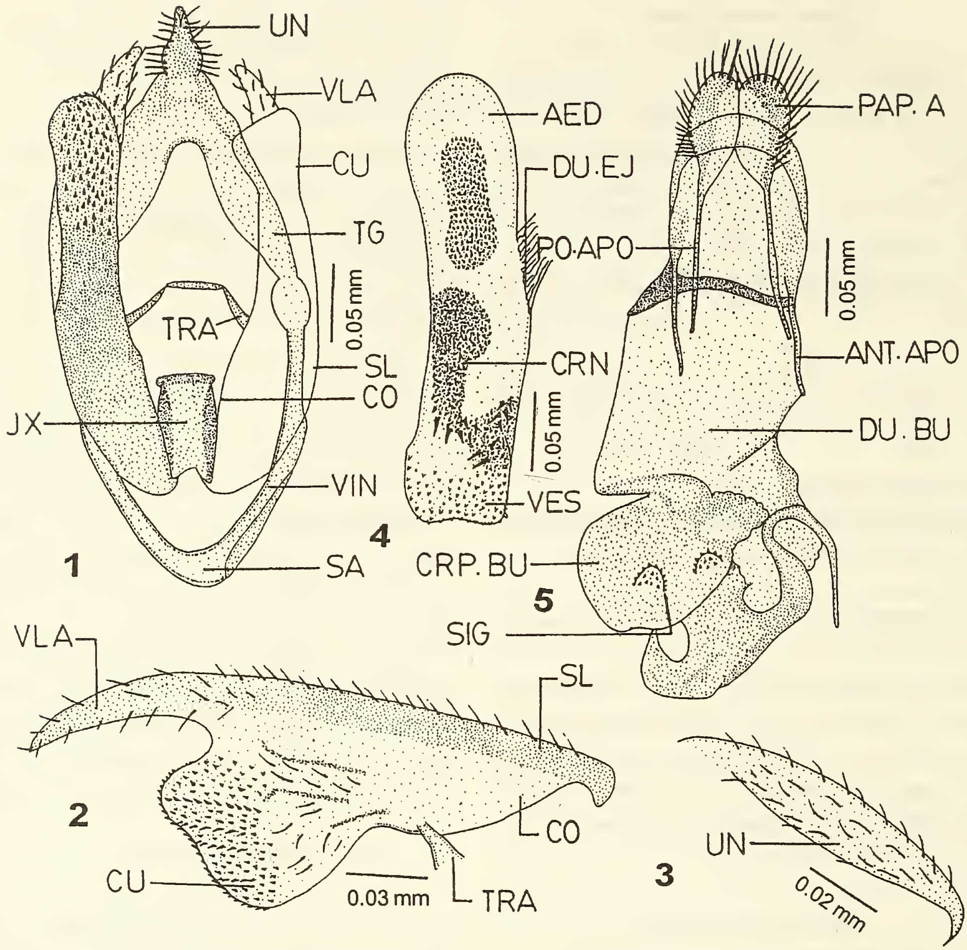
Mangina argus (Kollar) comb. nov.
(Figs 6-11)

Kollar, 1844, Hüge's Kaschmir, *4*: 467; Moore, 1882, Lep. Ceyl. *2*:105, Hmpsn. 1894, Moths Ind. *2*: 51

Genitalia: As described for genus diagnosis.

Material Examined: Himachal Pradesh: Nauni, 1.viii.1994, 1 ♂; Sikkim: Namchi, 2.v.1995, 1 ♂; Manipur: Ukhrul, 20.ix.1994, 1 ♂; Meghalaya: Jowaii, 30.ix.1994, 1 ♀; Cheerapunjee, 2.x.1994, 1 ♀; Uttar Pradesh: Dehra Dun, 18.x.1991, 2 ♀♀; Kempty Falls, 4.vi.1993, 2 ♂♂, 1 ♀; West Bengal: Kurseong, 28.iv.1995, 1 ♂, 3 ♀♀; Coll. Amritpal Singh.

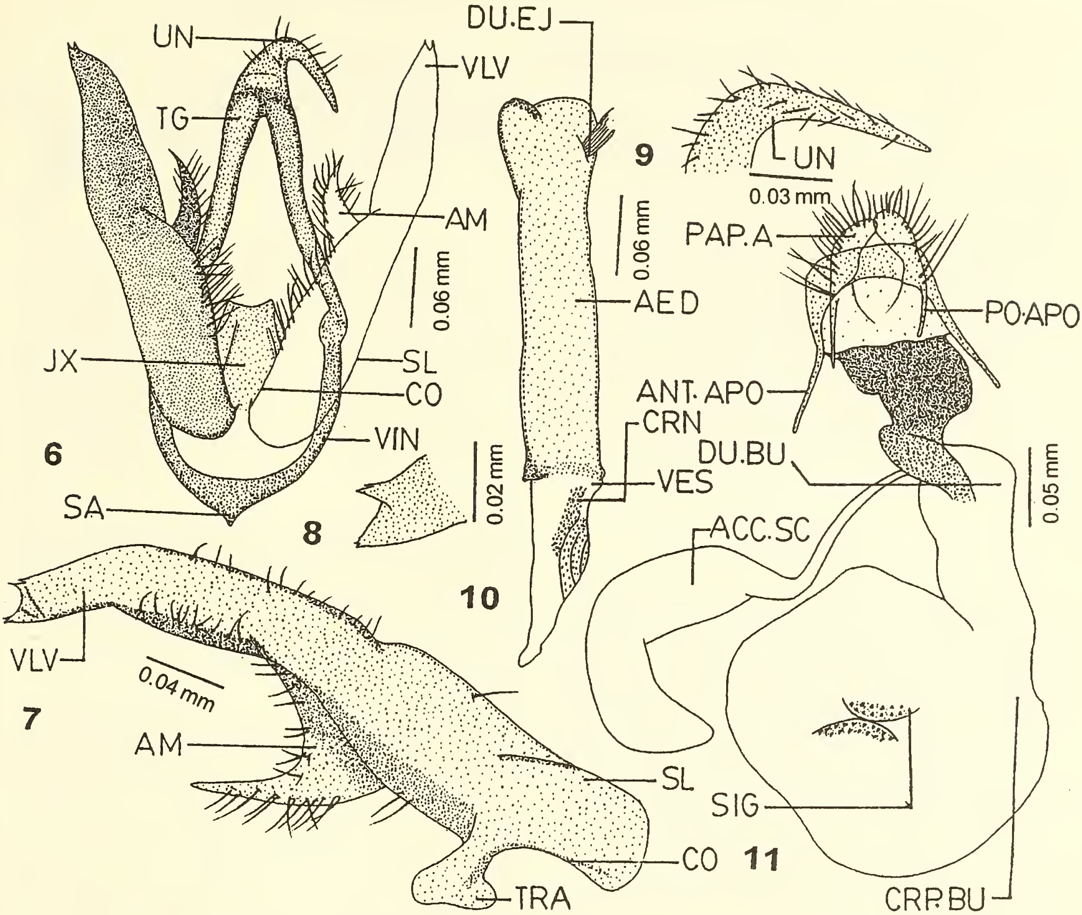
Remarks: As mentioned earlier, *argus* Kollar fails to conform to the description of genus *Argina* Hübner and is also non-congeneric



Figs 1-5: *Argina astrea* (Drury): 1-4. Male genitalia; 5. Female genitalia

Abbreviations: AED: Aedeagus, ANT.APO: Anterior apophyses, CO: Costa, CRN: Cornuti, CRP.BU: Corpus Bursae, CU: Cucullus, DU.BU: Ductus Bursae, DU.EJ: Ductus ejaculatorius, JX: Juxta PAP.A: Papilla Analis, PO.APO: Posterior apophyses, SA: Saccus, SIG: Signum, SL: Sacculus, TG: Tegumen, TRA: Transtilla, UN: Uncus, VES: Vesica, VIN: Vinculum, VLA: Valvula

with an allied genus *Utetheisa* Hübner, and other genera of Subfamily Arctiinae. Thus, a new genus *Mangina* is suggested for this species and the diagnosis of the new genus and its type species *Argina argus* Kollar is given. The present and correct status of the species becomes *Mangina argus* (Kollar) comb. nov. The new genus *Mangina* is closely allied to *Argina* Hübner with respect to wing maculation, wing venation, presence of glandular patch and tornus of hindwing, and a pair of tibial spurs. The unique morphological features particularly the genital structures, namely uncus, valva and aedeagus of male genitalia and corpus bursae, ductus bursae and signa of female genitalia of the type species *argus* make it totally different from the type species *astrea* Drury of genus *Argina* Hübner.



Figs 6-11: *Mangina argus* (Kollar) comb. nov.: 6-10. Male genitalia; 11. Female genitalia.

Abbreviations: ACC.SC: Accessory sac, AED: Aedeagus, AM: Ampulla, ANT.APO: Anterior apophyses, CO: Costa, CRN: Cornuti, CRP.BU: Corpus Bursae, DU.BU: Ductus Bursae, DU.EJ: Ductus ejaculatorius, JX: Juxta, PAP.A: Papilla Analis, PO.APO: Posterior apophyses, SIG: Signum, SL: Sacculus, TG: Tegumen, TRA: Transtilla, UN: Uncus, VES: Vesica, VIN: Vinculum, VLV: Valva

Acknowledgements

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A NEW FRESHWATER CYPRINID FISH *ASPIDOPARIA* FROM THE CHATRICKONG RIVER, MANIPUR, INDIA[1]

KEISHING SELIM AND WAIKHOM VISHWANATH[2]

(*With two text-figures*)

Key words: *Aspidoparia*, new species, Manipur

The freshwater cyprinid genus *Aspidoparia* Heckel distributed in India and west Asia, is represented by two species in India, namely *A. morar* (Hamilton-Buchanan) and *A. jaya* (Hamilton-Buchanan). This paper describes *A. ukhrulensis* from the Chatrickong river draining the southeastern part of Ukhrul district, Manipur. The species is characterised by 14 rows of scales in front of the dorsal fin; lateral line scales 35-37; pectoral fin I, 12-13; pharyngeal teeth 2 rows, lateral scale count from lateral line to ventral fin 2; absence of barbels; deciduous moderate scales. It has smaller head width, and less height at occiput. This species differs from *A. morar* and *A. jaya* in having fewer lateral line scales. A key to identification of the genus is provided.

INTRODUCTION

The genus *Aspidoparia* was erected by Heckel (1843) to accomodate *A. jaya* and *A. morar*, both described by Hamilton-Buchanan (1822) from India. Two species of the genus have been recognised so far: *A. morar* (Hamilton) and *A. jaya* (Hamilton), both from India. The relationships of *Aspidoparia* have been discussed by Howes (1979) based on osteological characters. This genus is Oriental, but is also represented in west Asia (Kottelat 1984). A new species of *Aspidoparia* is described from the Chat¨ickong river, flowing through Chatric village in Ukhrul district, Manipur, India. The Chatrickong is formed by two important rivers Khunukong and Sanalok, which meet at Dha-ado and flow as Chatrickong for about 5 km in the Indian region, then on to Myanmar, finally joining the Chindwin drainage.

During a survey on June 6, 1996, we collected 4 specimens from the lower course of Chatrickong in Ukhrul district, which is the waterhead of the Chindwin drainage in eastern Manipur. This report describes a new species of *Aspidoparia*. Notes on *A. morar* and *A. jaya*, and a key to the genus *Aspidoparia* are also provided.

MATERIAL AND METHODS

The specimens were collected by side tracking, locally known as Kongkakhai, on the side of the lower course of the river. The fishes were fixed and preserved in 10% formalin. The type specimens are deposited in the Manipur University Museum of Fishes (MUMF); measurement and counts follow Jayaram (1981). The body proportions are expressed as percentage of Standard Length (SL) and Head Length (HL). Lateral transverse scales were counted as scales between lateral line and dorsal fin origin, and also from lateral line to the base of the ventral fin origin.

Aspidoparia ukhrulensis sp. nov.
(Figs 1-2)

Local name: *Boikisi.*

Holotype: MUMF 1025, 75.1 mm SL, Chatrickong river, Ukhrul district, Manipur, 150 km from Imphal, India. 6.vi.1996, coll. Keishing Selim

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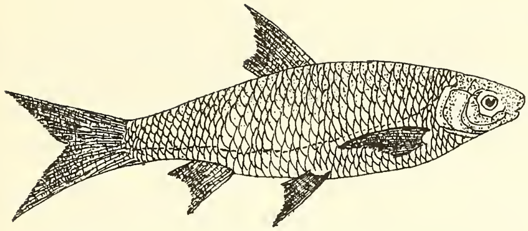

Fig. 1: *Aspidoparia ukhrulensis* sp. nov.

Paratype: MUMF 1026, 1027, 1028 (3 specimens), 69.5-76.7 mm SL. Data same as holotype.

KEY TO THE SPECIES

a. Lateral line scales 52-60; anal fin with 7 branched rays, pharyngeal teeth in two rows .... *A. jaya*
b. Lateral line scales 38-42; anal fin with 9 branched rays, pharyngeal teeth in three rows .... *A. morar*
c. Lateral line scales 35-37; anal fin with 9 branched rays, pharyngeal teeth in two rows .... *A. ukhrulensis*

DESCRIPTION

D ii, 7; P i, 12-13; V i, 7; A iii, 9; PDS 14; Ll. 35-37; Ltr 5/1/3; C 19 (10+9). Body elongate and subcylindrical; abdomen rounded. Head length short compared to depth of body, mouth small and inferior, jaws short, no barbels. Lower jaw curved without any lip, pharyngeal teeth in two rows. Dorsal fin inserted opposite to the origin of pelvic fin and nearer the base of the caudal fin. The first simple dorsal ray is strong, osseous and not serrated posteriorly. Pectoral fins long and pointed posteriorly, their length longer than the dorsal height, not reaching the pelvic fin base. Pelvic fins do not reach anal fin base. Vent opens at the base of anal fin. Scales moderate and deciduous. There are 5 rows of scales between the dorsal fin origin and the lateral line and 2 rows from the lateral line to the base of ventral fin. Lateral line is complete with 35-37 scales and is slightly curved. Caudal fin forked with lower lobe longer than the upper.

Proportional Measurements: Body depth 26.85-28.48, Head length 21.15-23.30, Caudal length 24.36-27.10, Predorsal length 54.82-56.32, Dorsal fin height 20.00-20.90, Pectoral fin length 23.70-24.74, Pelvic fin length 15.53-16.29, Anal fin height 13.66-14.73, Caudal peduncle length 13.42-14.11, Caudal peduncle depth 10.90-11.21 in SL. Head width 49.69-50.00, Head height at occiput 75.46-80.00, Eye diameter 30.86-32.51, Interorbital space 33.33-36.80, Pectoral length 96.36-100.09, Snout length 24.53-27.87 in HL.

Colour: Back silvery-white and belly pale white.

Habitat: Found only at the lower course of the river where the current was slow. It does not come upstream where the current is strong, preferring pools with sandy bottom.

Etymology: The species is named after the type locality, Ukhrul district, Manipur.

Distribution: Chatrickong river, Ukhrul district, Manipur, India.

Remarks: *Aspidoparia ukhrulensis* differs from *A. morar* (Ham.-Buch.) in having fewer lateral line scales (35-37 vs. 38-42); fewer predorsal scales (14 vs. 17-18); pharyngeal teeth 2 rows vs. 3 rows; lateral transverse scale count from lateral line to the base of ventral fin 2 vs. 3. It also differs from *A. jaya* in lateral line scale count, 35-37 vs. 52-60. We feel that *A. jaya* and *A. ukhrulensis* are different species as the lateral line scale variation range differs vastly. Hence, physical examination was not done in *A. jaya*. Only that of *A. morar* was done for comparison.

Aspidoparia jaya (Ham.-Buch.)

Cyprinus jaya Ham.-Buch., 1822, Fish of Ganges: 333, 392 (type locality: northern Bihar)

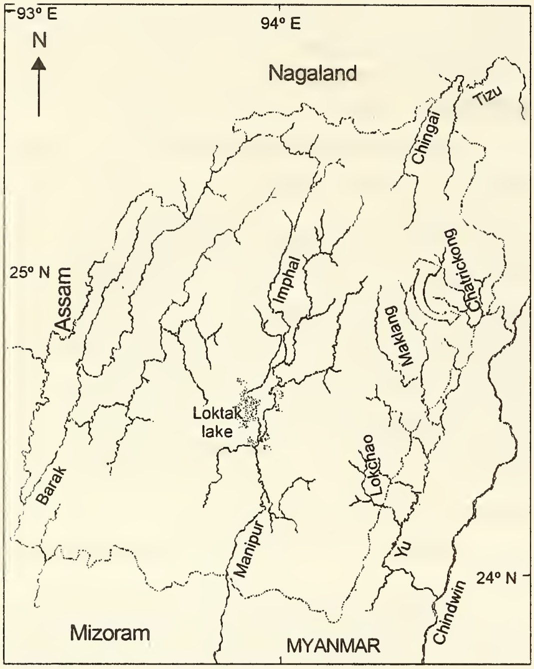

Fig. 2: Drainage map of Manipur showing the collection site

Material examined: None. (Description after Talwar & Jhingran, 1991)

Diagnosis: A species of *Aspidoparia* with anal fin having 7 branch rays; pharyngeal teeth in two rows; lateral line scales 52-60.

Distribution: INDIA: Gangetic provinces and Assam; Nepal and Bangladesh.

Remarks: The species differs from *A. morar* in branched anal rays 7 vs. 9; lateral line 52-60 vs. 38-42; pharyngeal teeth 2 rows vs 3 rows.

Aspidoparia morar (Ham.-Buch.)

Cyprinus morar Ham.-Buch., 1822, Fish of Ganges: 264, 384, pl. 31, fig. 75 (type locality: Yamuna river and Tista river).

Material examined: MUMF/888-90, 88.5-138.4 mm in SL, 26.ii.1997, Leimatak river.

TABLE 1
COMPARISON OF MORPHOMETRIC DATA AND COUNTS OF *A. UKHRULENSIS* SP. NOV. WITH THOSE OF *A. MORAR* FROM MANIPUR

Characters	Holotype MUMF/ 1025 *A. ukhrulensis*	Paratype MUMF/ 1026-28 *A. ukhrulensis*	Paratype MUMF/ 888-90 *A. morar*
Head length	21.70	21.15-23.30	19.24-22.20
Body depth	27.82	26.85-28.48	25.53-27.75
Caudal length	24.36	24.36-27.10	27.02-27.55
Predorsal length	56.32	54.82-56.32	53.82-59.26
Dorsal fin height	20.90	20.00-20.90	27.23-24.83
Pectoral fin length	23.70	23.70-24.74	22.48-24.83
Pelvic fin length	16.51	15.53-16.51	14.01-16.55
Anal fin length	14.51	13.66-14.73	13.80-14.39
In % of HL			
Head width	49.69	49.69-50.00	50.00-65.40
Head height at occiput	75.46	75.46-80.00	73.00-100.0
Eye diameter	32.51	30.86-32.51	29.66-38.38
Interorbital space	36.38	33.33-36.80	27.96-45.97
Pectoral fin length	100.09	96.36-100.09	100.11-100.54
Snout length	24.53	24.53-27.87	25.00-30.33
Counts			
Dorsal fin	ii, 7	ii, 7	ii, 7
Pectoral fin	i, 13	i, 12-13	i, 14
Ventral fin	i, 7	i, 7	i, 7
Anal fin	iii, 9	iii, 9	iii, 9
Caudal fin	19	19	19
Barbels	nil	nil	nil
Lateral line scales	35	35-37	38-42
Lateral transverse scales	5/1/2	5/1/2	5/1/3
Predorsal scales	14	14	17-18
Pharyngeal teeth rows	2	2	3

Diagnosis: The species is characterized by nine branched anal rays; pharyngeal teeth in three rows. Lateral line complete with 38-42 scales.

Distribution: INDIA: North India. Iran, Pakistan, Nepal, Bangladesh, Myanmar and Thailand.

Remarks: It differs from *A. ukhrulensis* in the number of predorsal scales 17-18 vs. 14; lateral line scales 38-42 vs. 35-37; lateral transverse scales 5/1/2 vs. 5/1/3; pharyngeal teeth 3 rows vs. 2 rows.

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■ ■ ■

A NEW SPECIES OF *RHODODENDRON* LINN. FROM ARUNACHAL PRADESH, INDIA[1]

G.D. Pal[2]

(*With one text-figure*)

Key words: Rhododendron, new species, Arunachal Pradesh

A new species of Rhododendron is described with illustrations. A comparative table of taxonomic characters is also appended here to distinguish the new taxon from the closely related species.

During plant explorations in the Lower Subansiri district, Arunachal Pradesh, an interesting species of rhododendron was collected in Tale Valley at 3,200 m altitude. It is an extremely elegant epiphytic shrubby species that grows among moss, lycopods and various lichens on fallen tree trunks. Its yellow funnel-campanulate flowers remain above the surrounding mossy carpet and its charming beauty at once catches the botanist's eye. The plant as a whole attains only half a metre in length, of which the lower creeping parts remain covered with moss and only the upper dichotomies with leaves are erect. A critical study of the specimens and scrutiny of the literature revealed it to be a new species, which was confirmed by Dr. H.H. Davidian of Royal Botanical Garden, Edinburgh, U.K.

The new species is placed under the subsection: *Lepidota,* section: *Rhododendron* of the subgenus: *Rhododendron.* Cullen (1983) recognized the subsection: *Lepidota* (Hutchinson) Sleumer [Bot. Jahrb. 74:531. 1949] as a small group of three species namely *R. lepidotum* Wall. ex. G. Don, *R. lowndesii* Davidian and *R. cowanianum* Davidian distributed mainly in the Himalayas. The subsection is characterized by: small shrubs or shrublets up to 2 m; lower surface of leaves with broad translucent scales; inflorescence terminal, 1-5 flowered; calyx deeply 5-lobed; corolla usually lepidote outside; stamens 10 and actinomorphically arranged; ovary lepidote; style impressed, short and sharply deflexed.

Rhododendron nayari sp. nov. (Fig. 1)

R. lowndesii Davidian affine, sed fruticosis epiphyticis; foliis coriaceis, glabris, marginibus integribus, valde recurvatis; floribus solitariis, pedicellis 6-8 mm longis; calyces lobis oblongo-spathulatibus, 6-10 mm longis; corollis campanulatis, apicibus loborum manifeste incisuratis; capsulisque oblongo-ellipsoides differt.

Holotypus: Arunachal Pradesh, Lower Subansiri district, Tale Valley, 3,200 m, 17.iv.1980, *G.D. Pal* 77690 A (CAL). Isotypi *Ibid*., *G.D. Pal* 77690 B; *Ibid*., *G.D. Pal* 77690 C & D (ARUN).

Small decumbent, epiphytic shrublets up to 50 cm tall, profusely branched; branches mostly dichotomous, woody, terete, 2-4 mm across; younger parts densely brownish or ferrugineo-brownish pilose, older parts become glabrate, rough; bark thin, grey or ashy-grey; leaf-scars prominent. Leaves whorled, 4-8 together, rarely ternate, crowded at the apices of branches, lower leaves deciduous; elliptic to

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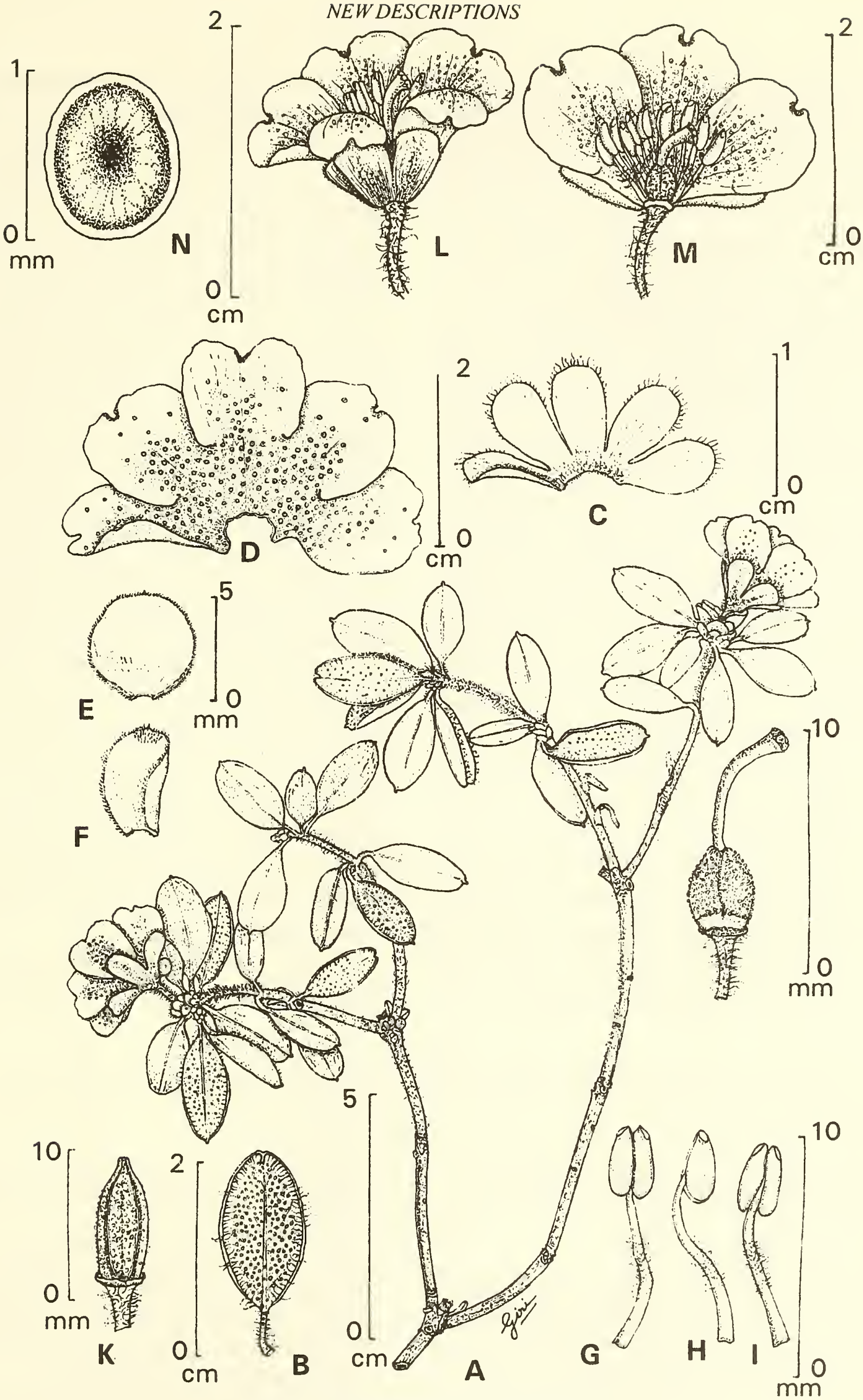

Fig. 1: *Rhododendron nayari* sp. nov.
A. Habit; B. Leaf (lower surface); C. Calyx; D. Corolla; E & F. Bracts; G-I. Stamens; J. Gynoecium; K. Capsule; L. Flower; M. Flower split open; N. Bud (enlarged, lower view).

elliptic-oblong, rarely obovate, (10 to) 16-20 (to 25) x (4 to) 8-11 (to13) mm; acute to subrounded at base; obtuse or subrounded at the club-shaped mucronate apex; margins entire, strongly recurved, loriform setose; lateral nerves 6-8 on either side of midrib, hardly conspicuous; coriaceous, glabrous; upper surfaces dark green, sparsely lepidote or not, turn dark brown; lower surfaces dull green, profusely lepidote with scales, become light brown or grayish-brown on drying; scales golden-brown, nearly uniform, circular in outline, sunken in pit, shortly stalked, central part flattened, rim broad, translucent; petioles (1.5 to) 2.5-5 (to 6.5) mm long, ferrugineo-brownish pilose, often intermixed with a few scales; sometimes sessile scaly leaves appear in between whorl of leaves; scaly leaves lanceolate or narrowly oblong, 6-15 mm long, ciliate. Winter buds ovate; bud-scales imbricate. Flower solitary, terminal; pedicels 6-8 mm long, densely ferrugineo-brownish pilose and lepidote; bracts in series, imbricate, often cover the lower half of pedicels, reddish, coriaceous, broadly oblong to suborbicular, (2 to) 4-5 (to 7) x (2 to) 4-4.5 (to 6) mm, rounded at mucronate apex, dorsally glabrous, ventrally glabrous or finely whitish tomentose at apices, ciliate. Calyx deeply 5-lobed, yellowish; tube about 2 mm long, ferrugineo-brownish pilose and lepidote at very base; lobes unequal, oblong-spathulate, 6-10 x 4.5-6 mm, membranous, glabrous, rarely with a few scales on dorsal surface, filiform-acicular ciliate at apical margin. Corolla yellow, campanulate or funnel-campanulate; tube 7-9 mm long; lobes broadly obovate-oblong to suborbicular, 6-9 x 8-12 mm, distinctly notched at apex; corolla-tube and crest of lobes dorsally covered with golden-brown, translucent, domed scales; scales sparse or even absent towards margin; pits shallow. Stamens 10; filaments unequal, 5-8 mm long, Actinomorphically arranged, brownish pilose at or near the middle; anthers black, oblong, 2.5-3 x 1.5 mm, emarginated at apex, bilobed, each lobe opens by a large, terminal, oblique pore. Ovary ellipsoid, 5-locular, about 3 x 2.5 mm, densely lepidote with scales; scales absent at base; style impressed into the top of ovary; deflexed at or above the middle, glabrous; stigma swollen, consisting of five fleshy lobes. Capsules oblong-ellipsoid, 6.5-7 x 3.5-4 mm, lepidote with scales when young; older capsules glabrate, rugose, breaking into five strong, woody, straight valves, placenta not separating from central axis; seeds fusiform, about 4 mm long, unwinged and without a distinct tail.

Type: Arunachal Pradesh, Lower Subansiri district, Tale Valley, 3,200 m,

TABLE 1
DISTINGUISHING CHARACTERS OF *RHODODENDRON LOWNDESII* AND *R. NAYARI*

Rhododendron lowndesii Davidian	*R. nayari* sp. nov.
1. Small lithophytic, creeping, pubescent shrublets, about 10 cm high.	1. Small epiphytic, decumbent, glabrous shrubs, about 50 cm high.
2. Leaves thin, pubescent; margins slightly crenate, hairy.	2. Leaves coriaceous, glabrous; margins entire, strongly recurved, loriform-setose.
3. Inflorescence 1-2 flowered; pedicels 2.5-4.3 cm long.	3. Flower solitary, terminal; pedicels 6-8 mm long.
4. Calyx-lobes ovate or ovate-oblong, 2.5-3.5 mm long	4. Calyx-lobes oblong-spathulate, 6-10 mm long.
5. Corolla rounded or bell-shaped, red-spotted or streaked; lobes rounded without notch.	5. Corolla campanulate or funnel-campanulate, yellow; lobes prominently notched at apex.
6. Ovary cone shaped; style short, much curved.	6. Ovary ellipsoid; style about 5 mm long, slightly deflexed after anthesis at or above the middle.
7. Capsules cylindric, *c.* 5 mm	7. Capsules oblong-ellipsoid, 6.5-7 mm.

17.iv.1980, *G.D. Pal* 77690 A (Holotype CAL). Isotypes: *Ibid., G.D. Pal* 77690 B; *Ibid., G.D. Pal* 77690 C & 77690 D (ARUN).

Fl. & Fr.: March-May.

Ecology: Grows on tree trunks in moist, shady places at higher elevations and is associated with various species of mosses, lycopods, lichens and bamboos.

Rhododendron nayari sp. nov. is closely allied to *R. lowndesii* Davidian, but the former can be easily distinguished by glabrous, coriaceous leaves with loriform-setose margin; solitary, terminal flower with smaller pedicel; large, oblong-spathulate calyx-lobes; corolla-lobes distinctly notched at apex and oblong-ellipsoid capsules (Table 1).

The specific epithet of this beautiful rhododendron is given in honour of Dr. M.P. Nayar, Ex-Director, Botanical Survey of India for his valuable contribution to the understanding of the taxonomy of Indian plants.

Acknowledgements

I thank the Director, Botanical Survey of India, Calcutta, for all facilities and encouragement. Sincere thanks to Dr. H.H. Davidian, 'Specialist in Rhododendron', Royal Botanic Garden, Edinburgh for confirmation of the new taxon. I also thank Dr. G.S. Giri, Scientist-SE, Central National Herbarium, Howrah, for kindly going through the manuscript and providing line drawings, and Dr. V.J. Nair for providing the Latin diagnosis of the new species.

■ ■ ■

REVIEWS

1. EVALUATING EDEN SERIES NO. 3. WHERE COMMUNITIES CARE: COMMUNITY-BASED WILDLIFE AND ECOSYSTEM MANAGEMENT IN SOUTH ASIA by Ashish Kothari, Neema Pathak and Farhad Vania. Published by Russel Press, Nottingham, UK. Published in 2000. Pp. xv+222. Price not mentioned.

The conservation of biodiversity and its judicious use is especially important in sustaining the livelihood of poor households across the world. Despite its critical importance, we continue to lose biodiversity at an alarming rate. For example, forests are being destroyed at the rate of an acre a second (World Bank), with unimaginable loss of biodiversity and serious erosion of income of the rural poor. Several factors contribute to the destruction of biodiversity — lack of clear property rights, distorted markets and prices, lack of appreciation of the value of biodiversity, poor management, paucity of financial resources, and general development pressures. The need to address these factors to conserve our biodiversity resources is great. Several successful examples at balancing biodiversity conservation with economic modernization exist at the national level. Conventions on Biological Diversity and the Global Environment Facility provides important means by which to share such examples across countries and scale them up rapidly. By bringing together a large body of policy makers, academics and representatives from the private sector and society, I hope that this book will provide the opportunity to exchange innovative solutions among development practitioners across the Subcontinent. Furthermore, to identify practical and workable solutions to sustainably manage this critical resource.

Kothari *et al.* deal with the above points in different case studies. In this book, there are eight case studies from India, three from Nepal, two from Pakistan and five from Sri Lanka. Seven case studies were carried out as part of the Review, on the basis of the following criteria: coverage of a range of (a) countries in the region; (b) ecosystem types; (c) ethnic communities; (d) initiatives, including government, NGO and community-led; and (e) availability of an active partner at the site or nearby.

The book is structured as follows: introductory chapter explains the background and objectives of the Review, and the methodology and definitions used; Chapter 2 provides an ecological and socioeconomic profile of South Asia; Chapters 3 to 8 provide descriptions of the history and current status of wildlife/biodiversity conservation in general, and Community-based Wildlife Management (CWM) in particular, in the six countries; Chapter 9 draws out the major ecological, economic, social, and policy-level impact of CWM in the region; Chapter 10 is a detailed regional analysis of the issues arising out of CWM, experiences in these countries, and challenges facing the future of CWM; Chapter 11 highlights next steps at local, national, and regional levels.

The book also gives an overview of the studies on community-based wildlife management, or rather, community-based conservation. Out of the 25 biodiversity hot spots in the world, India is one of the megadiversity countries and has the second largest human population. The case studies show how community-led conservation is important to biodiversity for long term conservation. For insta.: e, in Keoladeo National Park (India), the management plan was prepared after discussion with the concerned communities living on the fringes of the Park. In Jigme Dorji National Park

and Royal Manas National Park (Bhutan), the WWF had undertaken socioeconomic surveys and made management plans, with the help of the local communities. Forest Conservation and agro-biodiversity revival at Jardharaon. Uttar Pradesh (India), through the Chipko movement, the famous Himalayan struggle to protect natural forests against timber contractors and other forces of destruction.

The authors are of the opinion that, even today, the Governments and even some development organizations dictate most of the terms of biodiversity conservation with or without the consent of concerned communities. Conservationists have realized that without the full participation of local communities, biodiversity conservation will get nowhere. Despite this realization, even today, the amount of resources spent by many development organizations on community consultations and community involvement in most projects remains inadequate. Do we have adequate community involvement in biodiversity conservation? This book is worth reading, to realise the importance of community participation in biodiversity conservation and wildlife management. The book is produced by Kalpavriksh (India) in collaboration with the International Institute of Environment and Development (UK).

■ M. ZAFAR-UL ISLAM

2. NATURE'S SPOKESMAN: M. KRISHNAN AND INDIA'S WILDLIFE: Edited by Ramachandra Guha. Published in 2000. Oxford University Press. (22.5 x 14.5 cm), pp. 291. Price Rs. 595/-.

Some people say that it is not proper to review a book about your life-long hero, as objectivity is lost, but I will review this book, no matter what people say. I am proud to say that I am one of the many Indian naturalists who grew up cherishing M. Krishnan's highly readable newspaper column 'Country Notebook'. I do not remember when I first read his column in 'The Statesman', perhaps it was in 1964, when I was 14 years old, but what I do remember clearly is that I used to look forward to the otherwise rather sedate and boring *The Statesman* which carried Krishnan's fortnightly column. I still have old clippings from the late 1960s and 1970s.

M. Krishnan was not only an extraordinary naturalist and photographer, he was a philosopher, poet, art critic, translator, literary historian, Tamil littérateur, essayist and an artist. He was also a cricket buff! He had written columns on the Madras Test Match in 1952, for *The Statesman*. No doubt, with such varied talent, Krishnan was abrasive and opinionated, though not arrogant, according to people who knew him personally.

Nature's spokesman is edited by another fan of Krishnan, well-known environmental historian Ramachandra Guha. After a brief introduction, which Guha calls 'The Worlds of M. Krishnan', he presents a selection of 68 essays. It must have been extremely difficult for Guha to select these essays from the hundreds scattered in *Madras Mail*, *The Statesman*, *The Hindu*, *The Indian Express*, *The Illustrated Weekly of India*, *Shankar's Weekly* and others, since each piece needs to be leisurely savoured. I recommend this book for the field, where it should be read unhurriedly, beside a fireplace, in some remote, forest guesthouse, perhaps under a lantern! Only then may the reader appreciate the beauty of sentences like: 'unpredictable exuberance of the mighty Brahmaputra' (p. 153), 'it is easy to be solemnly pompous over a pledge of commitments'

(p. 193), 'charming confidence that animals in a sanctuary often develop towards humanity' (p. 212), the list is endless as the book is full of such unforgettable sentences. Writing about the antics of the members of the Indian Board for Wildlife during the discussion on commercial exploitation of captive crocodiles in his article 'Captive-bred mugger (p. 193-195), he writes "I could not argue the point... as by that time people were getting visibly restive. The aroma of lunch, being laid out in the next room pervaded the air, and as an experienced ethologist I knew how futile, even dangerous at times, gustatory arousal and its consummation."

To modify Orwell, all articles are good, but some are better than others. My favourites are: 'The Shawk' (pp 35-36) about the two Egyptian vultures which come daily to Tirukkalukunram, near Mahabalipuram, which shows Krishnan's sense of humour, and 'Ecological patriotism' (pp 250-255). The latter, I think, should be compulsory reading for all conservationists and forest officers. Reading this article I found that, like 35 years ago, when I used to sit with a dictionary to comprehend M. Krishnan's writing, I still had to use a dictionary to understand words such as 'desideratum' (p. 251) which means something wanted or needed. Do I need to write more about the value of this book?

■ ASAD R. RAHMANI

3. FISH FAUNA OF MANIPUR, by W. Vishwanath. Manipur Association for Science & Society (MASS), Imphal. Published in 2000. Pp. viii + 143, 6 plates. (21 x 13.5 cm), price Rs. 100/- or $ 6; library edition price Rs. 350/- or $ 10.

In the last two decades, there has been a spate of books on Indian fish taxonomy. While these dealt with fishes from all over India — and even neighbouring countries — there is a new star on the horizon. The 'Seven Sisters', as our northeastern states are known, are a far cry from the national mainstream, what with vast distances, logistic constraints and a beautifully quaint culture. It was, therefore, a surprise to me to come across one of the best written treatises on fish taxonomy from one of these distant states, namely Manipur. The excellent work is by Dr. W. Vishwanath, a protégé of Dr. K.C. Jayaram, who is himself the author of two outstanding fish books. May their tribe increase and flourish!

This compact booklet — it has 143 pages — covers 167 species. Manipur, though politically a part of India, borders on Myanmar (Burma) and has the advantage of having an admixture of typically Indian fish fauna in its Barak-Brahmaputra drainage in its western half and the Imphal-Chindwin drainage in its eastern half. Thus, many of its fishes, though known in Myanmar, are the basis of new geographic records from India.

The book starts with brief but necessary notes on Manipur's geomorphology, water resources, biogeography and history of fish taxonomy in the region. Although Manipur is considered a 'developing' state, the author has consulted the latest taxonomic classifications of Eschmeyer (1990), Kottelat (1990), Rainboth (1991), Nelson (1994), Banarescu & Nalbant (1995) and Banarescu & Herzig-Straschil (1995), so that the classification in the book is up to date.

Vishwanath has taken great care to go through the proofs for the main section (page 26 onwards); I could locate only one mistake on page 47 where "paired fish lateral" is given (It should be "paired fins lateral"). However, it is in the general coverage, and more so the Systematic Index (S.I.) where he has slipped up badly. Thus, page 10 has as many as five spelling errors in the

technical names, namely Coelecathimorpha instead of Coelacanthimorpha, Tetrapods (should be Tetrapoda), Chimaeriform(e)s (e missing), Rajiform(e)s (e missing), Coelac(a)nthiformes (a missing); on page 11 Sc(h)ilbeinae (h missing). On page 12, the Family Nandidae is wrongly shown as an Order, Cic(h)lidae (h missing) and Anbantidae (should be Anabantidae); on page 13 standard lenght, dorsal fin lenght (instead of length); on page 21 *berdmorrei* (only one 'r'); on page 22 Tros(c)hel (c missing); on page 23 *N. viridescens* (should be *viridiscens*), *H. fossilis* bloch (instead of Bloch), Exoceotoidei (should be Exocoetoidei). On page 23, the Suborder Belonidei is wrongly given as Belonidae. On page 24, *Johnius* Blochl ('l' is superfluous, also the subfamilies Badinae and Nandinae are wrongly given as Badidae and Nandidae, Family Cichlidae is wrongly spelt as Chiclidae, while on page 125 it is spelt Ciclidae.

The top lines on many pages in the Systematic Index are missing, e.g., Subfamily Cobitinae (p. 85), *Lepidocephalus guntea* (Ham.-Buch.) (p. 88), Subfamily Bagrinae (p. 90), *Mystus bleekeri* (Day) (p. 93), Suborder Beloidei (p. 113), Subfamily Apocheilinae (p.114), Subfamily Mastacembelinae (p. 117), Suborder Tetraodontoidei (p. 133) and Subfamily Tetraodontinae (p. 133).

There are many slips in the pagination too. Thus, *C. chitala* is shown in the Systematic Index (S.I.) as on page 28, whereas it is actually on page 29. Similar errors are: genus *Aorichthys* Wu (S.I. page 91, actually 90); *A. aor* (Ham.-Buch.), genus *Batasio* Blyth and *B. tengara* (Ham.-Buch.) (S.I. 92, actually 91), Family Siluridae (S.I. 94, actually 93), genus *Wallagoi* Bleeker (S.I. 96, actually 95).

But these errors and aberrations are only minor irritants and do not detract from the otherwise excellent publication. Accurate line drawings are given for each genus so as to acquaint the novice of the shape of the fish. Photographs are also given of 66 representative fishes. The price for the library edition is rather stiff, at Rs. 350/-.

■ B.F. CHHAPGAR

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MISCELLANEOUS NOTES

1. HOMOSEXUALITY IN ASIATIC LION: A CASE STUDY FROM GIR NATIONAL PARK AND SANCTUARY

The Asiatic lion (*Panthera leo persica*) is a social animal and its natural sexual behaviour is in general restricted to heterosexualism, but there are a few exceptions. The heterosexual behaviour of Asiatic lions of the Gir Protected Areas (PA) is recorded and described in detail by Joslin (1973) and Sinha (1987). In 1982, Chauhan reported homosexuality (lesbianism) in the Asiatic lioness of Gir. But homosexuality in male Asiatic lions, which are prime territorial males, has never been recorded before in detail with photographic evidence.

A pair of prime territorial males about 6 to 7 years, from Khokhra, showed this unusual behaviour when they were not with females. This dominant pair hold a territory of about 70 sq. km, which falls in Sasan (Amritvel, Gebi-amba, Bavalbalachowk, Kankai naka area) and Dedakadi range (Pilipat, Kadeli, Ratanguna area) of the western part of Gir PA, for the last one and a half years. This area has four prime females with cubs. The Khokhra males have an established record of mating with three females of the Khokhra territory, of which two females now have four cubs.

Homosexual activity among these two males was first observed by a group of trackers in November 1999, for five days continuously, and later in December 1999, for three days. The method of mounting, time taken during mounting, repulsive action after mounting seen in the Khokhra males is similar to heterosexual mating.

Only the larger male would mount the smaller one, which showed a subserviant attitude and played the role of the receptive partner. The smaller male rarely growled, unlike the larger during mating. Each mounting lasted for about 12 to 23 seconds and the gap between two incidents varied from 4-12 minutes. The frequency of mating increased during the morning and evening hours. Of the 45 mountings observed, the smaller male showed repulsive action in four cases, which may be due to the actual anal penetration during mating. During the homosexual activity period, the animals avoided food, but changed their area, which is unusual during heterosexual mating.

The areas in which the Khokhra males move have a low female population, and most of the females are engaged in rearing cubs. Due to overlapping of territories, there is increasing pressure on the males to protect their territories from other males. There is also a possibility that the Khokra females are mating with other males. November and December are the peak period for mating of lions in Gir PA. All these factors may have contributed to the unusual sexual behaviour observed.

Acknowledgements

I thank the trackers of Gir PA and Shri Chaitanya Joshi and Shri Kautilya P. Bhatt for their help in field observation.

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2. PREDATION BY LEOPARD *PANTHERA PARDUS* IN MAJHATAL HARSANG WILDLIFE SANCTUARY, WESTERN HIMALAYA

We analysed leopard (*Panthera pardus*) scats to get an indication of its food habits in Majhatal Harsang Wildlife Sanctuary (MHWS: 76° 55'-77° 5' E and 31° 15'-31° 18' N), Himachal Pradesh. The scats were collected between November 1992 and May 1993. MHWS is located in the middle Himalaya, with an altitude from 575 m to 1,985 m above msl. The area has a subtropical monsoon climate. Himalayan chir pine *(Pinus roxburghii)* and ban oak *(Quercus leucotrichophora)* forests, and subtropical *Euphorbia* scrub are the major vegetation types (Champion and Seth 1968).

Besides leopard, mammalian predators in the area are jungle cat (*Felis chaus*), Himalayan black bear (*Selenarctos thibetanus*), and Himalayan yellow-throated marten (*Martes flavigula*). Lammergeier (*Gypaetus barbatus*) is a potential avian predator. The potential prey base in MHWS includes barking deer (*Muntiacus muntjac*), wild pig (*Sus scrofa)* and sambar (*Cervus unicolor*), besides goral *Nemorhaedus goral*. Goral is the most abundant, followed by barking deer. Wild pig and sambar are very rare. During this 6 months study, there were more than 300 sightings of goral, about of 10 barking deer, 1 of sambar and none of wild pig (Mishra 1993, Mishra and Johnsingh 1996). Although there are sampling biases in this information (e.g. very little sampling in the low-lying areas of the Sanctuary, which are used more by sambar and wild pig), we think that it does give a rough indication of the relative abundance of wild ungulates. Relatively large groups (>20) of rhesus macaque (*Macaca mulatta*) and common langur (*Presbytis entellus*) were seen repeatedly in the area, though we do not have any abundance estimates. Though porcupine (*Hystrix indica*) was never seen, probably because of its nocturnal habits, indirect evidence and local information indicated that it was common. Both porcupine and rufous-tailed hare (*Lepus nigricollis ruficaudatus*) damage crops in the villages and are known to be fairly common. One hundred and six species of birds were identified during the study, including nine species of pheasants (Mishra 1997).

MHWS has 17 villages with a human population of about 750. Livestock rearing is one of the main occupations besides cultivation. The potential prey base for leopard includes livestock (goat, sheep, cattle, buffalo) and village dogs.

Forty-seven leopard scats were collected from areas between 1,400-1,950 m above msl. All scats were washed in running water, over a sieve, and oven dried at 60 °C. Of these, 17 scats were analysed at the field station, for which no standardized procedures were followed. Prey remains such as hair, claws and hooves were examined. Hairs were viewed under a compound microscope at 100x magnification and were identified by comparing them with reference slides. The remaining 30 scats were analysed using techniques standardised by Mukherjee et *al.* (1994). Twenty hairs were picked per scat and identified by the medullary method.

The results are summarised in Table 1. Cattle remains were found in 33% of the scats followed by langur (30%), goral (30% and dog (23%). Remains of buffalo, rodents, goat and hare occurred in less than 15% of the scats. Fifty percent of the scats contained the remains of a single prey species, 33% contained 2 prey species, and 17% contained 3 prey species. The mean number of species per scat was 1.6. We found remains of birds in 3 of the 17 scats analysed at the field station. Remains of buffalo, cow, goat, goral and rodents were noted in one scat each.

Although the sample size is inadequate to comment on leopard diet, some interesting trends are indicated. Remains of domestic and wild animals are represented in almost equal numbers of scats (23 and 24 respectively). This indicates

TABLE 1
PERCENT OCCURRENCE OF PREY REMAINS IN LEOPARD SCATS (10, 20 AND 30; CUMULATIVE) FROM MAJHATAL HARSANG WILDLIFE SANCTUARY, INDIA

Prey species	10 scats	20 scats	30 scats
Cattle	30	25	33
Langur	40	30	30
Goral	10	20	30
Dog	30	25	23
Buffalo	30	20	13
Rodents	10	10	10
Goats	0	10	10
Hare	0	0	3
Unknown	0	5	6

high predation on domestic animals, despite there being seemingly abundant wild prey, especially goral. Buffalo remains in the diet indicate scavenging by the leopard — there was high winter mortality among buffaloes during the study period. Local information confirmed that there is no actual predation on buffalo, though cattle are frequently killed.

Our results indicate relatively high predation on goral (Table 1). In another goral area, in Rajaji National Park in the Shiwalik Hills of northwest Himalaya, we had found a total absence of leopard predation on this species (Mukherjee, unpubl. data), where it was among the less abundant species and occurred in more difficult terrain than the other prey. The majority of prey in Rajaji was formed by the more abundant chital (*Axis axis*). In MHWS, we did not find any remains of barking deer, wild pig, sambar, rhesus macaque, or porcupine, in any of the scats. Except for the last two, these species are uncommon in the study area. It is worthwhile to note the high levels of predation on common langur and a complete lack of it on rhesus macaque. The trend in Rajaji was similar, with no predation on the rhesus macaque, further data on which is yet to be published.

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3. A REPORT ON THE FOOD PLANTS OF SÁLIM ALI'S FRUIT BAT *LATIDENS SALIMALII*

A team of researchers visited the only known roosting cave of the highly endangered and endemic bat *Latidens salimalii* Thonglongya, on March 23, 1999, as part of the biodiversity assessment programme of Meghamalai region. The cave is situated in a deep gorge in a valley,

near a stream inside the Kardana Coffee estate, right down the Mettala peak (9° 42' N and 77° 24' E) at 460 m above msl. Coffee and other trees constitute the vegetation surrounding the cave, which serves as a night roost or resting place while feeding (Bates *et al.* 1994). The day roost is not known.

In 1972, Kitty Thonglongya described a new genus of bat *Latidens salimalii* (Sálim Ali's fruit bat) endemic to south India, based on one specimen collected by Angus Hutton from High Wavy mountain in 1948. Hutton erroneously identified it as *Cynopterus sphinx sphinx* (Vahl.). Muni and Thomas rediscovered this rare bat in April 1993 (Bates *et al.* 1994), in their preliminary survey of bats of High Wavy mountain. They collected six specimens and gave morphometric and anatomic details of this endemic species. *L. salimalii* is a medium sized fruit bat with an average forearm length of 67.3 mm. It is similar to *Cynopterus sphinx* in size, but without an external tail. The characters are well described in Bates and Harrison (1997). This bat is listed by IUCN as critically endangered (list 1), with small distribution area, decline of habitat and small population (Baillie and Groombridge 1996). It has entered the Guinness Book of World Records (1993) as one of the three most rare bats of the world. The distribution is presently believed to be restricted to a small population in High Wavy mountain. No information is available on its food or on any other ecological aspects. *Latidens* is closely allied to the southeast Asian genus *Penthetor* Anderson 1912 in general similarity of cheek teeth, and to *Thoopterus* Malsche, 1899 on account of similarities in skull morphology (Bates *et al.* 1994). *Penthetor* is known to feed on a wide variety of hard fruits and seeds from forest trees (Mickleburgh *et al.* 1992) and *Thoopterus* has been observed feeding on wild figs (Bergmans and Rozendaal 1988).

Just a few weeks prior to our visit, some other researchers had visited this cave and tried assessing the population using nets and visual observation (Arogyamoorthy pers. comm.). During this visit, we identified 2 fig and 3 other tree species from fruit parts present in the faecal heaps on the floor of the cave. The species identified were *Ficus beddomi*, *Ficus macrocarpa*, *Diospyros ovalifolia*, *Prunus ceylanicus* and *Eleocarpus oblongus*. All these trees were fruiting around the cave. This is the first report of the food plants of this endangered fruit-eating bat. According to the locals, the bats live there round the year, which implies that food was available throughout the year from fruiting trees in the surrounding forest and estates. Thus, survival of this endangered species, in its sole known habitat, is linked with the survival of these fruiting trees.

Along the valley, tree felling still continues as part of the coffee estate management. In some areas, patches are being replanted by *Erythrina* sp. and Silver Oak *Grevillea robusta*, which are of no use to the bat. If the authorities with the help of the coffee estate management do not take immediate steps to conserve the food plants, the future of this endemic and endangered bat, whose specific name honours a great ornithologist, is in peril. Though access to High Wavy mountain is restricted, habitat destruction and some level of predation by local workers (Bates *et al.* 1994) also pose a serious threat to the species.

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4. ON THE OCCURRENCE OF THE WILD WATER BUFFALO *BUBALUS ARNEE* IN THE BARAK VALLEY DISTRICTS OF ASSAM

(With one text figure)

The Asiatic wild water buffalo *Bubalus arnee* Kerr (*bubalis* Linn.) is in need of urgent conservation attention. Even stray information of both past and present distribution has become extremely important. An account of its status in northeastern India, the only stronghold of the species in the world, is given in Choudhury (1994). Here I report its past occurrence in the Barak Valley of southern Assam, comprising the districts of Cachar, Hailakandi and Karimganj (Fig. 1).

There is no mention of the wild buffalo in the literature of this area, except for a remark in Choudhury (1997a). During various field trips for primates and birds in the 1980s, I received a few reports about the occurrence of wild buffalo, but could not verify them. However, it was during a survey of grasslands as part of the Biodiversity Conservation Prioritisation Project (BCPP) in 1997 (Choudhury, 1997b) that I got concrete reports and could personally verify them. While many of the specimens were found to be mis-identifications of the gaur *Bos gaurus*, three horns of *Bubalus arnee* were examined and measured. Subsequently, only the reports of these reliable observers, who did not confuse gaur with buffalo, were accepted. The records are listed chronologically:

Late 19th Century: (a) I got reports from Karimganj district (A. Munim Mazumdar, ex-hunter, Hailakandi, *pers. comm.*) about the availability of horns. Two horns were examined, a male and a female, near Badarpur. However, both were shot from Jabda *haor* - Andhari *beel* area (24° 55' N, 92° 30' E) of Katigora, Cachar district, in the latter half of the 19th century by the late Hamidur Raza Choudhury. The specimens were magnificent animals (Table 1). (b) One shot dead in 1885-90 from *beel* no.18 near Hasiura (revenue villages: Rajyeswarpur pt VII & VIII) (24° 35' N, 92° 37' E) by Kutumia Choudhury, who was among the first settlers in Hasiura. The horn was preserved till 1940s (A. Majid Choudhury, Hasiura village, *pers. comm.*).

TABLE 1
MEASUREMENTS (IN CM) OF HORNS OF WILD WATER BUFFALOES EXAMINED IN BARAK VALLEY DISTRICTS

	Sp-1 (f)	Sp-2 (m)	Sp-3 (m)
Maximum spread	121.5	129.5	—
Tip to tip (span)	91.0	61.5	—
Sweep (across forehead)	242.0	317.0	—
Girth at base	32.0	50.0	44.5
Maximum length of a single horn	110.0	148.0	122.0

Sp (Specimen)- 1 & 2: Jabda *haor* - Andhari areas, Cachar district; Sp-3: Mahmodpur, Hailakandi district; Sp-3 was only horns without the skull; (m) = Male; (f)= Female.

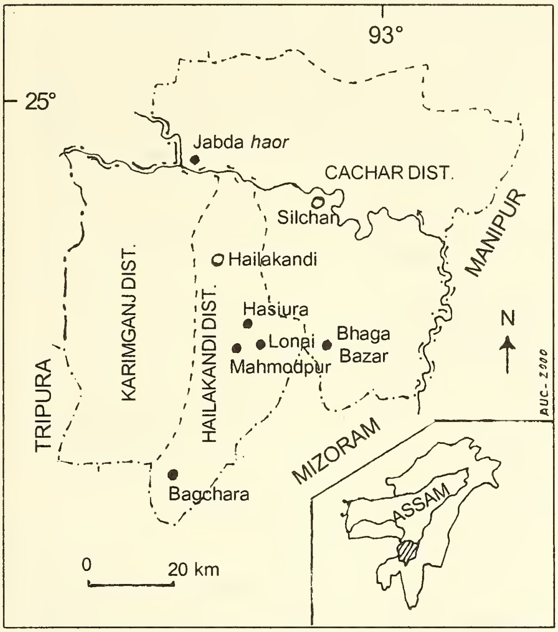

Fig. 1: Map of Barak Valley districts of Assam

Early 20th Century: The first authentic report, received during this study, was from Mahmodpur Village (24° 30' N, 92° 37' E) in Hailakandi district (A. Majid Choudhury, Hasiura village, *pers. comm.*). A bull had been shot near Itala *beel* at the turn of the 20th century, and its horns have been well preserved. The measurements of this magnificent specimen are given in Table 1.

1950: Two buffaloes were seen wallowing in a small pool, west of Bhaga Bazar (24° 30' N 92° 48' E) in Cachar district (Sharifunnessa Mazumder, 85 yrs, Bhaga village, *pers. comm.*). This old lady had fled her village during the post-partition riots and had taken shelter in the jungle when she saw the animals.

1950s: A few were seen till about 1955 in Bagchara (24° 12' N, 92° 30' E) and other areas of Innerline RF, Hailakandi district (Haji A. Haq Laskar, local leader, Nitainagar village, *pers. comm.*).

1960s: One bull was seen in mid-1960s at Kuarthol, near Lonai (24° 30' N, 92° 40' E; outskirts of Katakhal RF, Hailakandi district) (Harun Rashid Laskar, Hasiura village, *pers. comm.*). This was the last confirmed record of the wild buffalo in the Barak Valley districts.

After talking to old hunters and others who gave this invaluable information, I surmised that the wild buffalo existed in the Barak Valley districts till late 1950s. Stray animals were reported till about the late 1960s. No report of any surviving animal has been received after that, indicating its extinction from the area. The last of the animals reported were from Innerline RF of southern Hailakandi and southern Cachar, Katakhal RF of southeastern Hailakandi and in the low hills and valleys of southeastern parts of Karimganj and adjacent areas of Hailakandi. Because of the lack of vast stretches of grassland as are found in the Brahmaputra valley, the animals were possibly never abundant in the area. The buffaloes of Jabda *haor* complex vanished in the early decades of the 20th century.

Expansion of lowland paddy cultivation in the floodplains, poaching for meat and sport (shot at Jabda by a rich landlord, notified by the British regime) and encroachment in the low hills and valleys of the southern forested tract have resulted in the gradual decline of the small population of wild buffalo in the area.

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5. OCCURRENCE OF INDIAN PANGOLIN *MANIS CRASSICAUDATA* IN ALIGARH, UTTAR PRADESH

Neither of the two pangolins reported from the Indian subcontinent are known to occur in Aligarh area. The Indian pangolin *Manis crassicaudata* is reported from peninsular India, while the Chinese pangolin *M. pentadactyla* occurs in northeastern India. Therefore, it was quite surprising that a pangolin was sighted in Aligarh (27° 29' to 28° 11' N and 77° 29' to 28° 39' E) in May 1997. The animal was captured and subsequently killed by the inhabitants of a local village called Barola Jafrabad 3 km from the Aligarh Muslim University (AMU) campus. The pangolin was identified as *Manis crassicaudata* from the measurements noted below by the AMU Museology Department where it is now on display.

Date of collection	15.v.1997
Total length	105 cm
Length of head	10.5 cm
Tail	50.5 cm
Forelimb	8.5 cm + 5.5 cm (claw)
Hindlimb	7 cm + 0.75 cm (claw)
Width:	
Centre	48 cm
Shoulder	47.5 cm
Lower (hind) Portion	50 cm

I thank Dr. Abdur Raheem, Lecturer, Department of Museology, AMU, for providing detailed measurements.

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6. STRANDED WHALES ON THE GUJARAT COAST

In this note, we report six stranded whales seen between 1983 to 1998. We had personally seen four specimens in Kutch district. There are reports of cetaceans, dolphins, porpoises and whales in the waters of Gujarat. Whales, when seen dead in deep waters, are brought to the coast by inquisitive fishermen, or by the natural force of tides. The reports of such dead whales in the newspapers attract hundreds of people to see these gigantic marine mammals.

S.no.	Place	Date & year	Remarks
1.	Asharmata	April 1983	15.24 m
2.	Sindhrodi	March 1984	15.24 m
3.	Kalumbhar Island	August 1988	8.38 m*
4.	Bhadreshwar coast	February 1977	13.72 m
5.	Ganga creek	July 1997	6.10 m
6.	Jakhau coast	July 1998	4.27 m

*Blue Whale

It seems that most of the stranded whales seen in Gujarat coast are the blue whales *Balaenoptera musculus*; sometimes sperm whales *Physeter catodon* may also be observed, e.g. specimen No. 6 seen on Jakhau coast.

The cause of death of the whales is not known. Interestingly, three specimens out of the six were seen from February to April and the remaining from July to August.

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7. DEPENDENCY OF FAN-DRYING OF DARTERS *ANHINGA RUFA* AND LITTLE CORMORANTS *PHALACROCORAX NIGER* ON INCIDENT SUNLIGHT

(With one text-figure)

The spread-wing posture of cormorants and darters has long been the subject of scientific investigation (Kortlandt 1940, Clark 1969, Curry-Lindahl 1970). The main hypotheses in connection with this behaviour are that it is i. balancing posture (Stabler 1957); ii. intraspecific signal of successful fishing (Jones 1978); iii. aid to thermoregulation (Curry-Lindahl 1970, Hennemann 1982) or iv. wing drying strategy (Kortlandt 1940, Winkler 1983).

Strong support for the now generally accepted theory of wing-drying is provided by the fact that the plumage of both the cormorant and the darter is water absorbent for efficient underwater swimming through reduced buoyancy (Ruke 1968, Siegfried *et al.* 1975, Hennemann 1984). On the assumption that the spread-wing posture, which enlarges the area for absorption of solar radiation, does serve to dry the wings, the question arises: How do the birds dry their wings in the shade, or in the absence of direct sunlight? This study analyzes behavioural adaptation in these circumstances.

The study was carried out in the Keoladeo National Park, Bharatpur, Rajasthan, India. The area has a typical dry tropical monsoon climate (Ewans 1989, Scott 1989). Observations of spread-wing behaviour of little cormorants *Phalacrocorax niger*, and darters *Anhinga rufa,* were made from October 26 to November 2, 1990, during calm weather. Binoculars (10x40) and a compass were used to determine the orientation of the birds to incident sunlight. Birds were noted as being exposed to the sun or as sitting in the shade: periods when there was no sun (before sunrise and after sunset) were also noted. Steady spread-wing posture and active fanning ("fan-drying") spread-wing posture were treated as separate. Ambient temperature was measured with a black thermometer (bimetal) in direct sunlight. Statistical analyses of the birds' orientation to the sun followed standard methods (Schmidt-Koenig 1975, Fowler and Cohen 1986, Brown and Downhower 1988).

Spread-wing behaviour was shown by both species during daylight, mainly in the available direct solar radiation, which facilitates wing drying. The orientation of birds sitting or perching was not random, as the alignment of their backs and wing surfaces showed a highly significant correlation towards the sun (Rayleigh's test (Schmidt-Koenig 1975): $a = 0.67$; $p<0.01$; $n = 70$ for the little cormorant; $a = 0.84$; $p<0.01$; $n = 38$ for the darter). In the weak morning light before 0700hrs, and in the flat evening sun after 1700 hrs (Fig.1), only one cormorant and twenty-five darters (21.3% of 122 observations) showed the spread-wing posture.

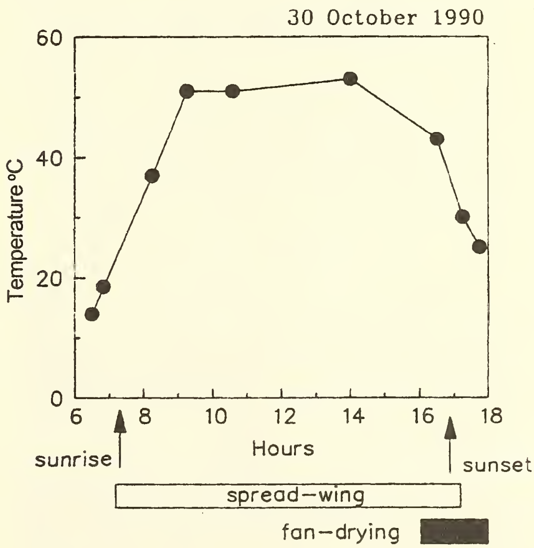

Fig. 1: Ambient temperature

Fan-drying was observed more frequently in the late afternoon than in the rest of the day. There were significant differences (χ^2 = 10.8; p<0.01; df = 1; n 30) for both species combined, between times before and after 1600 hrs. Fan-drying was also more frequent in the absence of incident sunlight (after sunset), as well as when birds were in the shade (χ^2 = 13.4; p<0.01; df = 1; n =27). A two by two contingency table χ^{2-} test showed highly significant (χ^2 = 52.1; p<0.01; df = 1; n = 111) associations between spread-wing posture and direct exposure to sùn, and fan-drying and no direct sun exposure.

Wing flap frequency during fanning was higher (t = 5.54; p<0.01; df = 64, Student's t-test) for the little cormorant at 3.3 beats per second (n = 14) than for the darter at 2.4 beats per second (n = 52).

There is now general agreement that sunning behaviour and the dark colour of the plumage of darters and cormorants serve to dry the wings (Simmons 1986). The spread-wing posture has, indeed, been described as the wing-drying posture in response to the "wings wet" stimulus (Kortlandt 1940). Darters and cormorants extract full advantage from the heat absorbing qualities of their black plumage by increasing the area exposed to the sun, thus facilitating evaporation (Lustick *et al.* 1978, 1980). Wing-drying has been suggested, in the American darter *(Anhinga anhinga)*, as a rapid thermoregulatory mechanism for re-establishment of a layer of air next to the skin to conserve metabolic heat (Hennemann 1982). The drying function of the spread-wing posture of little cormorants in Sri Lanka as a means of regaining airworthiness has also been emphasized (Winkler 1983).

Several studies show that darters and cormorants orient to the wind when this is strong (Siegfried *et al.*, 1975, Hennemann 1984, Winkler 1983). Orientation to the wind can be interpreted as a strategy to relieve the bird of the necessity of fanning its wings (Kortlandt 1940). In the absence of windy conditions, however, most species orient themselves perpendicularly to the incident radiation *(Anhinga anhinga*: Hennemann 1982; *Phalacrocorax niger*, *P. fuscicollis*, *P. carbo*: Winkler 1983; *P. harrisi*, *P. auritus*: Hennemann 1984; *P. capensis*, *P. neglectus*, *P. lucidus*, *P. africanus*: Siegfried *et al.*, 1975). The results of the present study show a significant correlation of directional orientation to the sun in calm weather and thus confirm the importance of direct sunlight for heat absorption and wing-drying.

In contrast to the relative volume of literature on the spread-wing posture, fan-drying has been the subject of little study and is mentioned only anecdotally (e.g. Portielje 1927, Winkler 1983, Hennemann 1984, Simmons 1986). Fanning was not observed very often in the present study, but when it was, it was almost exclusively in the shade or after sunset. This strongly suggests that lack of solar radiation, which is necessary for drying the wings, is compensated for by the active convection induced by fanning. It had also been postulated elsewhere (Hennemann 1982) that *Anhinga* fan wings and tail in preference to holding them steady under conditions of low solar radiation. In addition, it was shown by van Rhijn (1977) that herring gulls (*Larus argentatus*) improved evaporation by actively shaking their feathers.

The higher frequency of wing flaps, of the little cormorant seems to be correlated with its smaller body size compared to the darter (cf. Campbell & Lack 1985).

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8. WHITE STORKS *CICONIA CICONIA* ON MIGRATION

Migrating white storks *Ciconia ciconia* stop over to rest near Udayampatti village, about 5 km from Kalainzar Karunanidhi (KK) Nagar, Tiruchirapalli, Tamil Nadu. I have been seeing them here for the last 11 years. The area is roughly bounded by road from KK Nagar to Pudukkottai on the east, by the curving irrigation channel in the north and west. It extends to the south over and beyond the fallow and agricultural lands. A railway line runs parallel to the irrigation channel for some distance. The railway crossing, a roadside temple and tile factory chimneys far beyond in the southeast are unmistakeable landmarks. On the ground, the area appears as a loose rectangle, widening in the south, with a cart road running west to Vadugapatty. It is about 9 sq. km of mildly undulating, scrub jungle (about 30%) with grass

APPENDIX

S.No.	Year	Date of arrival	Date of Departure	Numbers	Remarks
1.	1988	19.10.88	20.10.88	120+	
2.	1988	24.11.88	26.11.88	280+	Heavy Storms Preceded Rain
3.	1989	26.10.89	27.10.89	60+	
4.	1989	28.1189	29.11.89	40+	
5.	1990	21.10.90	24.10.90	150+	
6.	1991	28.10.91	30.10.91	40+	
7.	1992	4.12.92	7.12.92	200+	Heavy Storm
8.	1993	21.10.93	23.10.93	50+	Continuous Rains
9.	1993	25.11.93	27.11.93	300+	Heavy Storm preceded Rains
10.	1993	30.11.93	3.12.93	150+	
11.	1994	26.10.94	28.10.94	90+	
12.	1995	did not visit			
13.	1996	did not visit			
14.	1997	16.10.97	28.10.97	250+	Early Rains Heavy Storm Preceded Rains
15.	1998	2.11.98	4.11.98	300+	Heay Storms Preceded Rains
16.	1998	20.11.98	21.11.98	90+	

and sparse trees *Azadirachta indica*, *Prosopis juliflora*, *Acacia leucophloea* and *A. nilotica.*

White storks are seen here from the beginning of the northeast monsoon. They arrive in the afternoon or evening, and depart in the night or early morning. Reaching in a downpour, often along with a storm, they depart when the rain stops and the sky clears. They generally land in small, unnoticeable groups of ten to twenty, the total sometimes reaching 300, but leave together as a group. They keep moving while foraging, with about 8 m in between individuals. The slush and waterlogging, grazing sheep, cattle or buffaloes do not bother them.

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9. DISTRIBUTION AND NESTING SITES OF THE BLACKNECKED STORK *EPHIPPIORHYNCHUS ASIATICUS*

The blacknecked stork *Ephippiorhynchus asiaticus* is threatened due to habitat loss and it is feared to have become very rare. In recent literature, concerned individuals have attempted to highlight the decline of this species and it is suggested that this species be placed in Category I of CITES (Rahmani 1989, Elliott 1992). The species is largely well-dispersed and rarely seen in groups. The ecology of the blacknecked stork is not clearly understood and information on its distribution and nesting is sparse and scattered. During a survey to assess the status of the sarus crane in India (May 1998 to March 1999), we had an excellent opportunity to record sites where the blacknecked stork feed and breed. This information is presented in Table 1.

Gujarat: Though known to be inhabiting inland wetlands, four birds were seen by the sea in Gujarat (Table 1). It was not clear if they had nested in the immediate vicinity or not. All the birds were resting on a dry sandy bank in the afternoon.

Haryana: Storks have not been previously reported from Bhindawas in Haryana. The locals have not seen the species breeding in the area, even though the lake has a large heronry, and several large trees in and around the lake. Sultanpur in Jajjar district of Haryana has been facing drought for the past three years continuously and water birds were not seen.

TABLE 1
RECORDS OF BLACKNECKED STORK (*EPHIPPIORHYNCHUS ASIATICUS*)
SIGHTINGS BETWEEN MAY 1998 AND MARCH 1999

State	District	Date of Sighting	Place	Number	Comments
Gujarat	Jamnagar	25.ii.1999	Jodiya Creek	4	Two adults and two juveniles
Haryana	Rohtak	16.vi.1998	Bhindawas	4	Two pairs
Rajasthan	Banswara	5.ii.1999	Haro Dam	1	—
	Bharatpur	23.v.1998	Keoladeo NP	3	All adults
Uttar Pradesh	Kheri	3.vii.1998	Dudwa NP	3	Two adults and one juvenile.
	Bahraich	27.i.1999	Road to Lakhimpur	1	Adult in uncultivated Field. (27° 57' N; 81° 27' E)
	Rai Bareli	28.i.1999	Samaspur	5	Two adults and three sub-adults.
	Aligarh	13.ii.1999	Shekha	4	All adults.
	Etawah	15.ii.1999	Near Etawah	2	Adults feeding in an inundated wheat field. (26° 46' N; 79° 7' E)
West Bengal	Jalpaiguri	18.i.1999	Chapramari	3	All adults, roosting on a tree.

Rahmani (1989) reports a couple of birds from this site.

Rajasthan: The Bharatpur population has been well monitored. During our observation, one of the blacknecked storks caught hold of a dabchick (*Podiceps ruficollis*) and proceeded to thrash it around for a while before swallowing it whole.

Uttar Pradesh: Always been known to be the stronghold for this species and our observations corroborate this view. Samaspur was seen to be a nesting site for the storks, previously unknown (Rahmani 1989). There were three sub-adults with two parent birds in a bird sanctuary. The parents were guarding the young ones by standing on either side of them. When approached, the adults uttered a loud call and took flight, followed by the sub-adults. An hour later, in another part of the sanctuary, they were seen again, sitting on the ground flanked by the parent birds.

Northeast: There are few records and the status is unclear. In Chapramari, West Bengal, the storks have been recorded breeding regularly and the forest staff of the Sanctuary offers protection to the nesting birds.

Others: We also visited several wetlands in Jammu, Punjab, Maharashtra, Bihar, Orissa and Madhya Pradesh, but did not sight any blacknecked storks.

Rahmani (1989) and Lopez & Mundkur (1997) have records from the Asian Census dating from 1989 and the trend is one of decline in sight records of the species. It is perhaps time to take stock of all available information regarding the blacknecked stork and initiate a conservation plan to save the species.

ACKNOWLEDGMENTS

The fieldwork was made possible through funding by the Wildlife Institute of India under the Sarus Crane Project and we thank Mr. S.K. Mukherjee and Mr. B.C. Choudhury for facilities. The Chief Wildlife Wardens of all the States were very helpful during the entire period of the survey and we thank them for permission to visit protected areas. We thank Sapna, Anil, Rajiv, Bivash, Purushottam and Surender for assistance during fieldwork.

April 7, 1999

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10. CINEREOUS VULTURE *AEGYPIUS MONACHUS* (LINN.), FAMILY ACCIPITRIDAE, IN KARNATAKA

On December 15, 1998 while on a visit to Harangi Dam, close to Kushalnagar in the Coorg district of Karnataka, a largish vulture was observed soaring over the western edge of the dam area. On approaching to have a closer look, its very dark chocolate brown underparts with pale feet and a smaller (unfeathered) head indicated it to be a cinereous vulture *Aegypius monachus*. The bird was observed for about 10 minutes. Later, the bird pulled its wings somewhat closer to its body and sailed overhead, as it glided towards the southeastern region of the barrage and disappeared from sight. Kushalnagar region comes within the eastern dry zone of Coorg district. The area where the bird was sighted was dry and open with scattered trees.

The cinereous vulture is widely distributed in central Asia, but in India it is mainly a winter visitor to the north and northwest (as far as Dhulia district in Maharashtra) (Ali and Ripley 1987). Occasional individuals have been sighted in Assam (Choudhury 1986) and Calcutta (=Kolkata) (Baker 1910) in the northeast. Although very rare, the species has been sighted in South India, once each in Nellore and Karimnagar districts of Andhra Pradesh (Perennou and Santharam 1990, Choudhury 1990) and in Pathanamthitta, Kerala (Kumar 1991). The present sighting is the first record of the species in Karnataka, and hence, is of interest.

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11. FIRST (?) SIGHTING OF CRAB PLOVER *DROMAS ARDEOLA* AND PIED HARRIER *CIRCUS MELANOLEUCOS* IN RAIGAD DISTRICT, MAHARASHTRA

On November 22, 1998 a flock of six crab plovers (*Dromas ardeola*) was seen on the sandy beach of Agardanda village near Murud-Janjira, Taluka Murud, Raigad district in the Konkan area of Maharashtra. Probably the same flock was sighted again on December 20, 1998 on the

Agardanda village creek during low tide. The distance between the nearest crab plover, a loner, and the small boat carrying the observers, was about 50 m. During 20 minutes of observation, three small crabs were eaten by a single crab plover. The crab plover was seen making a sudden rush at the crab, stabbing and lifting it up in the beak, shaking it vigorously and dropping it in the mud before eating it. It was observed that the crab plovers preferred to fly close to the sea surface. The bird had a characteristic call, *Twell-tak, Twell-tak* while on the wing.

In the morning between 0645 and 0930 hrs of the same day, at Dighi village, Taluka Shriwardhan, Raigad district, we also sighted a pair of pied harriers (*Circus melanoleucos*) on a mangrove mudflat. The harriers were soaring at a low height. At their approach, common sandpipers, greenshanks and redshanks took flight. On March 13-14, 1999, a pair of pied harriers was seen on the same mudflat in Dighi village.

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12. OCCURRENCE OF LESSER FLORICAN *SYPHEOTIDES INDICA* AT HOSOR, IN NASHIK DISTRICT, MAHARASHTRA

A lesser florican *Sypheotides indica* was sighted by one of us (BR) at the Hindustan Aeronautical Limited (HAL) complex at Hosor, 20 km from Nashik towards Dhulia on National Highway 3 on September 24, 1998. An adult male in full breeding plumage was observed performing display jumps on September 25, 1998 on a subsequent visit. (For a description of the HAL complex see Raha and Prakash, *JBNHS 98(1)*: 110-111).

The bird was recorded as common, and probably present throughout the year in Nashik and Ahmednagar during the 19th century (Hume and Marshal 1879; Sankaran *et al.* 1992). There were very few confirmed sightings of this bird in Maharashtra during a recent survey (Sankaran *et. al.* 1992), and none from Nashik district. We think this first confirmed sighting of the highly threatened species from an unreported site is worth recording.

The only threat to the lesser florican in this high security area are aircraft in flight, but since the flight frequency is very low, the probability of a hit is also low.

We thank HAL for permission to visit their complex. We thank Mr. Nag, Horticulturist for arranging all permits required to see the florican and Mr. Kale and Mr. Patnaik at the Air Traffic Control tower, HAL for their hospitality and sharing their natural history notes of the area with us.

December 1, 1998

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13. SIGHTING OF THE WHITETAILED LAPWING *VANELLUS LEUCURUS* (LICHTENSTEIN) IN THRISSUR DISTRICT, KERALA

During frequent visits to Enamavu Kole wetlands of Thrissur district, Kerala, N.K. Sathyan and I had an opportunity to observe an adult whitetailed lapwing *Vanellus leucurus*, a species vagrant to South India, The bird was seen on December 5, 6, 8, 14 and 25, 1998.

The adult *Vanellus leucurus* was more or less the same size as yellow wattled lapwing *Vanellus malabaricus*. The upperparts including head (except for the pale forehead and throat) were uniformly muddy brown. The breast was a little brown-tinged grey, or clear grey. Rest of underparts were white. Some narrow black and white bands were seen along the edge of the closed wings. The closed wing tips and bill were black. During early sightings, the long legs were bright orange-yellow, but later they became clear yellow. The dark eyes were very prominent on the pale face. In flight, pure white tail, broad white wing band and black primaries confirmed our identification. The under primaries were black and rest of underwing was white. The bird kept to the margins of the wetland. The feeding style was like that of other lapwings.

According to Ali and Ripley (1987) there is no record of this species from the extreme south of the Indian peninsula except Mysore. Baker and Inglis (1930) stated, "a winter visitor according to Stuart Baker, straggling as far south as Mysore." Sálim Ali (1969) and Neelakantan *et al.* (1993) did not include the whitetailed lapwing as they did not come across it anywhere during their survey of Kerala. Therefore, this new record from Kerala can also be considered a southern range extension of the species in South India.

April 7, 1999

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14. NEW SITE RECORD OF THE INDIAN GREAT BLACK WOODPECKER *DRYOCOPUS JAVENSIS* (HORSFIELD) FROM ANDHRA PRADESH

The Indian great black woodpecker *Dryocopus javensis* (Horsfield) is a local resident species distributed along the Western Ghats, from Surat Dangs to the hills of Tamil Nadu (Ali and Ripley 1987). It is also reported from Bastar (Ali, 1951), Jyothimamidi (Ripley *et al.*, 1988) and Udanti (Bharos, 1992). Bharos (1992) opined that the sightings of this species are probably under the influence of climatic conditions and local movements.

We report sightings of the Indian great black woodpecker from Kawal Wildlife Sanctuary (*c.* 19° 5' to 19° 20' N & 78° 32' to 79° 12' E), Adilabad district, Andhra Pradesh. The senior author first sighted an individual busily drumming on a teak trunk, in the teak *Tectona grandis* dominated mixed forest near Rampur on February 16, 1997. Subsequently, the species was sighted twice (February 28, 1998, September 26, 1998) from the same area. The literature does not report this species from the Telengana region of Andhra Pradesh. However, it may occur

sporadically between the Eastern Ghats and Satpura Hills.

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15. TREE PIE *(DENDROCITTA VAGABUNDA)* IN THE ARID THAR DESERT

In January 1998, while studying the Houbara bustard *Chlamydotis undulata* in the Thar desert of Rajasthan, we visited Dhanana, about 110 km west of Jaisalmer city. Dhanana is an extremely arid area with sand dunes all around. Large trees, except for a few khejri *Prosopis cineraria* trees, are absent. Beyond this village there is no human habitation, as it is close to the international border. There was a small Border Out Post (BOP) of the Border Security Force, atop a large sand dune. In the BOP area, there were three neem trees (*Azadirachta indica*). We reached Dhanana at about 1330 hrs, the temperature was about 36 °C. We were surprised to see a tree pie *Dendrocitta vagabunda* on one of the neem trees. This bird has not been reported here earlier.

The tree pie is usually found in forest plantations, secondary jungle, cultivation, human habitation, and gardens (Ali and Ripley 1983). Owing to the development of the Indira Gandhi Nahar Project and agriculture in the Thar desert, tremendous changes are taking place in the avifaunal composition of the Thar (Rahmani 1997). New forest birds can now be seen in the plantations developed on either side of the canal. However, Dhanana is located at least 150 km from the nearest canal plantation. Therefore, its presence in this extremely arid region is worth recording.

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16. POSSIBLE RANGE EXTENSION OF THE PENINSULAR BROOKS'S FLYCATCHER (*MUSCICAPA POLIOGENYS VERNAYI*) IN ANDHRA PRADESH

On February 14, 1999, while bird watching at the Nehru Zoological Park, Hyderabad, during the Birdwatchers' Society of Andhra Pradesh Project on the Survey of Protected Areas, we observed a small brown flycatcher in an *Acacia* bush at about 1.29 m. We got a good view of the bird for over 10 minutes through a 10 x 40 power binocular and noted the description as follows: olive brown upperparts with a greyish wash on the head. Tail brown. Fulvous throat, breast and underparts.

We referred to THE PICTORIAL GUIDE TO THE BIRDS OF THE INDIAN SUBCONTINENT (Ali and Ripley 1983) which was handy and identified the bird as the Brooks's flycatcher (*Muscicapa poliogenys*) from the description.

Back home, we consulted the COMPACT HANDBOOK OF THE BIRDS OF INDIA AND PAKISTAN (Ali and Ripley, 1987), for the range of this species, "The Eastern Ghats from northern Orissa (Mayurbhanj) to northeastern Andhra Pradesh (Vishakapatnam district); from the plains (± 600 m -Ed.) to 1000 m." Hyderabad city is at 540 m. A CHECKLIST OF BIRDS OF ANDHRA PRADESH (Taher and Pittie 1989), mentions only the Eastern Ghats as its range.

The Vernay Scientific Survey team had collected specimens of this bird at Anantagiri and Sankrametta in Vizagapatnam district. The bird was recorded as "Very common at Sankrametta and Anantagiri where these birds were breeding in April and May (La Personne). This new form of resident flycatcher of very limited distribution is one of the most interesting discoveries of the Vernay Survey." (Kinnear and Whistler 1933). Price (1979) had trapped and released this species at Lamasinghi in the Eastern Ghats of Andhra Pradesh and he notes these as "Common resident".

The only other flycatcher with which this bird can be confused is the female Tickell's blue flycatcher (*Muscicapa tickelliae*) which, however, has an orange-rufous throat and blue tail. The bird we saw clearly had a brown tail, and thus could not have been a female Tickell's blue flycatcher. The brown flycatcher (*Muscicapa latirostris*) has a conspicuous white throat, while this bird had a fulvous throat. In all respects, the bird we saw resembled closely the Brooks's flycatcher.

This, then, is an interesting sighting and can be an extension of the range of this species. It will be interesting to know if other sightings have been reported from this region, or adjacent areas, especially at lower heights than previously reported.

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17. RANGE EXTENSION OF SOUTHERN BLACKHEADED MUNIA *LONCHURA MALACCA MALACCA*

On November 2, 1998, a small flock of seven southern blackheaded munia (*Lonchura malacca malacca*) was seen among thickets of *Typha angustata*, in a nullah bed, nearly 600 m away downstream of Velania dam in Jhadol Tehsil, Udaipur district, Rajasthan. The flock was observed for five minutes from a distance of *c* 10 m. The munias were in black and white plumage, with white underparts. The flock moved along the nullah among *Typha* thickets.

Jhadol is situated in the southernmost part of Rajasthan near the Gujarat border. It falls in the high rainfall zone of Rajasthan, the average rainfall being nearly 600 mm per annum.

According to Ali and Ripley (1983), the subspecies *L. m. malacca* is found in the Indian Peninsula from Raipur, Pachmarhi and Bombay south to Kanyakumari and Sri Lanka. But Jamdar (1998) has recently recorded this subspecies for the first time from Keoladeo National Park, Bharatpur, Rajasthan. Bharatpur is in the eastern part of the state while Jhadol is situated in the extreme southern part. These recent sightings of this subspecies from two different parts of the state suggest a northward extension of its range.

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18. ADDITIONAL LIST OF THE BIRDS OF KANHA NATIONAL PARK, MADHYA PRADESH

Kanha National Park (KNP), situated in the Mandla and Balaghat districts of Madhya Pradesh, lies in the Maikal hills of the Central Indian highlands (22° 17' N, 80° 30' E). The total area of 1,945 sq. km comprises of the core area (940 sq. km) and a buffer zone (1,005 sq. km). Though the Park is well known for its abundance of large mammals and attracts thousands of tourists from all over the world, very little attention is focused on the rich diversity of birds. No serious ornithological field work has been done, considering its strategic location in the Satpuras, which are an important transit zone in Central India for migratory birds.

A systematic list of Kanha Tiger Reserve was first published by Newton *et al.* (1986). This list also gives a brief account of the topography, habitats and climate of Kanha along with maps of the Park. It contains 225 species, including resident and migratory birds. The present study provides additions to the list of Newton *et al.* (1986). In all, 35 new species are added, mainly migrants or stray species, based on our field observations and records from December 1986 to June 1998.

The nomenclature and taxonomic arrangement follows Ripley (1982), but no subspecific identifications have been made. To give this list continuity with the earlier one (Newton *et al.* 1986), we have used the same abbreviations for habitat and migratory status.

Additional abbreviation used: (R): Banjar

river, which was frequently visited. The river is an important landmark, as it forms the southwest boundary of the buffer zone of KNP, (S): Stray species or stragglers; (EDC, RA): Initials of authors, given for specific records.

Habitats: (M): Valley Meadow, (Salf): Sal Forest with *Flemingia*, (Salb): Sal forest with bamboo, (Mx): Mixed forest, (D): Dadar meadow, (N): Nullah or Stream, (T): Open water or tank, (C): Buffer zone farmland.

Migratory Status: [R]: Resident, observed in every month of the year, [W]: Winter visitor, observed only between October and April, [w]: Winter and Summer visitor, observed only between October and July, [B]: Breeding, observed at nest, as fledglings or carrying nesting material.

Systematic list

ARDEIDAE

Little green heron *Ardeola striatus*: (N) [w] Surwahi nullah, April 1997. Also seen at Kisli anicut, Ganghar nullah in the first week of May 1997 (EDC).

Black bittern *Ixobrychus flavicollis*: (R) [W] Banjar river (Mocha) a solitary bird, March 1990 (EDC). Another solitary bird on Banjar river in March 1996 (RA).

CICONIDAE

Painted stork *Mycteria leucocephala*: (T) [W] Phoota talao, Kanha. A single bird seen in January 1992. The bird stayed for 8 days only (RA).

Openbill stork *Anastomus oscitans*: (T, M) [w, B] Phoota Talao, Kanha, December 1998. Sondhar meadow March 1998 (RA). Sondhar tank, February 1998 (EDC). A large nesting colony of these birds exists in village Tarka near Bamhri Banjar (86 birds were seen in July 1997 with 31 nests; more nests were under construction). Nesting activity initiated around the first week of July; nesting observed in the same area since July 1987.

ANATIDAE

Greylag goose *Anser anser*: (T) [W] 14 birds seen at Sondhar tank in December 1996. A flock of 34 birds seen again at Sondhar tank in December 1997 (RA).

Brahminy duck *Tadorna ferruginea*: (R) [W] A pair seen in Banjar river, Mocha, March 14, 1990 (EDC). Also reported by locals in winter, further up the river.

Comb duck *Sarkidiornis melanotos*: (T) [W] A flock of 14 birds seen in Bishanpur tank in January and February 1998 (RA).

ACCIPITRIDAE

Bonelli's eagle *Hieraaetus fasciatus*: (M) [S] Soaring over Kanha meadows. 5 different sightings in January-February 1998 (RA).

Booted hawk-eagle *Hieraaetus pennatus*: (M) [S] Only one sighting of an exhausted looking bird atop *Bombax ceiba* on Kanha meadows in January 1998 (RA).

Greyheaded fishing eagle *Ichthyophaga ichthyaetus*: (T) [W] Only one sighting at Shravantal, January 1994 (RA).

Osprey *Pandion haliaetus*: (R, C) [W] One sighting in the buffer zone in Mocha village in February 1998 and also sighted once over Banjar river in Mocha (RA).

TURNICIDAE

Button quail *Turnix tanki*: (Mx) [W] A dead bird found in Mocha village, possibly dropped accidentally by a bird of prey in January 1998 (EDC). Also a small flock in Mocha village was seen on January 31, 1998 (EDC). D'Abreu (1935) records it as a resident for erstwhile Central Provinces, now Madhya Pradesh (MP).

GLAREOLIDAE

Small Indian pratincole *Glareola lactae*: (T) [W] 3 birds in flight over Rhonda tank, February 5, 1997 (Toby Sinclair, *pers. comm.*)

Both D'Abreo (1935) and Hewetson (1955) recorded it as seen on major river banks in central India. The bird appears to be a resident in MP, with considerable local movements.

CHARADRIIDAE

Little ringed plover *Charadrius dubius*: (R) [w] Banjar river, Mocha. A small flock in March 1992 (EDC), a few birds also seen on Banjar river in March 1997 (RA). D'Abreu (1935) and Hewetson (1955) recorded it as a breeding bird for central India with fairly widespread distribution.

Common sandpiper *Tringa hypoleucos*: (N) [S?] Only one sighting in Kanha nullah on way to Link No. 09 in January 1998 (EDC). This is the only sighting of the species from December 1986 to June 1998. Definitely not a common visitor.

LARIDAE

Indian river tern *Sterna aurantia*: (T) [W] Only one sighting near Kanha anicut in January 1995 (RA). Very rarely seen outside the Park, not as abundant and common as recorded by D'Abreu (1935) and Hewetson (1955).

COLUMBIDAE

Little brown dove *Streptopelia senegalensis*: (M, C) [W] Absent in winter, but returns around March-April. Several sightings on Kanha meadows and in the buffer zone (EDC, RA).

Indian plaintive cuckoo *Cacomantis passerinus*: (M, Salf, Mx, C) [w, B?] A common cuckoo that arrives just before the monsoon (May). Heard and seen in the core areas as well the buffer zone. Sighted every summer from 1987 (EDC). Possibly breeds here in summer. D'Abreau (1935) records it as a resident bird for Central Provinces and states that the bird was observed with eggs taken from the nest of Franklin's wren warbler.

STRIGIDAE

Scops owl *Otus scops*: (Salf, Mx) [W?] The unmistakable call is heard regularly in the night from March onwards. Rescued a chick from Kipling Camp in Mocha, buffer zone in May 1997 (RA). An adult bird was rescued from crows, near Kanha Museum, in May 1996 (EDC). Possibly breeds here in summer.

Forest eagle-owl *Bubo nipalensis*: (Salf) [S?] A single bird seen in dense sal forest near Sondhar in Mukki range in February 1994 (RA). Essentially a dweller of dense forest from Himalayas to northeast India and resident in the Western Ghats and southeastern Ghats. Perhaps this record from Kanha is the only one for central India.

Spotted owlet *Athene brama*: (Mx) [R, B] A resident pair seen in Mocha village in an old banyan tree. This pair was also seen with chicks in April 1991, sometimes near Khatia gate in the evenings, perched on overhead electrical cables (EDC). One sighting near Kanha meadows (RA).

Mottled wood owl *Strix ocellata*: (Mx) [W?] A pair was seen and heard during one winter November 1994 to January 1995, in Mocha village (EDC). This is the only record that we have around Kanha. It is very interesting to note that it is a resident around Bandhavgarh National Park, which is just a hundred miles to the northeast of Kanha, where it is seen throughout the year.

CAPRIMULIDAE

Common Indian nightjar *Caprimulgus asiaticus*: (Mx) [w] Seen and heard in and around Morcha village in the summer, from April onwards. A bird with 3 eggs seen near Mocha village in May 1996, in relatively open, rocky land (EDC).

ALCEDINIDAE

Lesser pied kingfisher *Ceryle rudis*: (R, T) [S?] A pair seen in Kanha anicut in February 1995 (RA). One bird seen at least on 4/5 occasions

around Banjar river in Mocha village. Seems to be fairly common in the jheels and tanks of Mandla district. Probably avoids heavy forest.

MEROPIDAE

Chestnutheaded bee-eater *Merops leschenaulti*: (M) [S?] A flock of 8/10 birds seen in May 1994 at Bhapsa Behra meadows near Link No. 8/9 junction. Also seen in May 1995/ 1996. In May 1996, the birds stayed for more than 15 days (passage?). Not recorded by D'Abreu (1935) or Hewetson (1955) for Central India. This record from Kanha may be the first from Madhya Pradesh.

Bluebearded bee-eater *Nyctyornis athertoni*: (Salf) [S?] A single record of a solitary bird perched on a tree on Kanha Ghat in February 1995 (Shahid Ali, *pers. comm.*).

PICIDAE

Heartspotted woodpecker *Hemicircus canente*: (Salf) [S?] A single sight record (Belinda Wright, *pers. comm.*). D'Abreu (1935) and Hewetson (1955), reported it as rare, found only in Bastar and Chanda in Central Provinces.

ALAUDIDAE

Short-toed lark *Calandrella cinerea*: (M) [w, S?] A single bird recorded from Kanha meadows near Phatyak nullah on April 8, 1993 (Shahid Ali, *pers. comm.*).

CAMPEPHAGIDAE

Smaller grey cuckoo-shrike *Coracina melaschistos*: (Salf, Mx) [W, S?] A pair seen near Kope Dhubri in sal forest on February 3, 1998. D'Abreu (1935) mentions one record from Chikaldara. The present record from Kanha is perhaps the only one from Madhya Pradesh.

PYCNONOTIDAE

Black Bulbul *Hypsipetes madagascariensis*: (Salf, Mx) [S?] A single bird seen in mixed Sal forest on Aurai road on February 3, 1998 (RA). D'Abreu (1935) mentions about one record of this bird from Chikaldhara.The present record from Kanha is perhaps the only record of this species from Madhya Pradesh.

MUSCICAPIDAE

Brown flycatcher *Muscicapa latirostris*: (Mx) [w, B] Observed parents feeding two fledgelings in a nest on *Woodfordia fruticosa*, in May 1987 in Mocha village (EDC). Ripley (1982) mentions a disjunct population of the species in the Vindhya Ranges. D'Abreu (1935) records it as a resident.

Pied chat *Oenanthe picata*: (M) [W] A solitary bird often seen on Kanha meadows during winter. Recorded in December 1997 - January 1998 (RA).

Smallbilled mountain thrush *Zoothera dauma*: (Mx, D) [W, S?] Solitary bird sighted at Bijadadar on April 5, 1996. Another was seen at Bamhnidadar on April 6, 1996 (EDC). A passage migrant?

NECTARINIIDAE

Yellowbacked sunbird *Aethopyga siparaja*: (Mx) [W] A regular winter visitor, but not many seen. A pair was sighted in February 1992; one male observed in February 1993/94/ 96. January 1995, February-March 98. Normally their arrival coincides with the flowering of *Woodfordia fruticosa* whose flowers are laden with nectar in the morning.

EMBERIZIDAE

Ortolan bunting *Emberiza hortulana*: (N) [S?] A single bird seen on Patak nullah near Kanha meadows, in December 1994 (Shahid Ali, *pers. comm.*). Only a couple of sightings of this bird have been recorded so far from India. Ripley (1982) records it as a vagrant.

Most of the birds recorded were stragglers or rare winter visitors to Central India. No major

fieldwork was done, and most of the records are a result of opportunistic bird watching. Some of these birds have not been recorded previously by either D'Abreu (1935) or Hewetson (1955). Species recorded here but not mentioned by D'Abreu (1935) or Hewetson (1955) are given in the following table.

The sightings of the last six species in Kanha National Park given in Table 1 is of certain interest. The forest eagle-owl (*Bubo nipalensis*) is a resident of Himalayas, southern Western Ghats and southern Eastern Ghats, and inhabits dense evergreen and moist-deciduous forest (Ripley 1982). The present record is the only one from central India from a moist deciduous forest. The chestnutheaded bee-eater (*Merops leschenaulti*) is also a bird of the hills of the north and northeast India, Eastern and Western Ghats complex. But our recent records show that the birds pass through central India regularly in summer (passage migrant?), suggesting the possible migration of the northern population to the south during winter. The yellowbacked sunbird (*Aethopyga siparaja*) is another interesting record from Kanha. D'Abreu (1935) recorded it from Balaghat, and Hewetson (1955) never saw it anywhere in Madhya Pradesh (MP). Our observations show that it is a regular winter visitor from the Himalayas, possibly to other places in east MP, apart from Kanha. D'Abreu (1913) published a note in the *JBNHS* on a bird he shot in Balaghat, as the range extension of the Himalayan yellowbacked sunbird (*Aethopyga seheriae*). The ortolan bunting (*Emberiza hortulana*) is definitely a straggler, as there have been only two or three previous records from India (Ripley 1982).

TABLE 1
BIRD SPECIES OBSERVED IN KANHA TIGER RESERVE NOT RECORDED IN THE CENTRAL PROVINCES BY D'ABREU (1935) [*] OR IN MADHYA PRADESH BY HEWETSON (1995)[+]

Black bittern	*Ixobrychus flavicollis* +
Greylag goose	*Anser anser* +
Bonelli's eagle	*Hieraaetus fasciatus* +
Booted hawk eagle	*H. pennatus* +
Osprey	*Pandion haliaetus* +
Forest eagle owl	*Bubo nipalensis* +
Chestnutheaded bee-eater	*Merops leschenaulti* +*
Black bulbul	*Hypsipetes madagascariensis* +*
Smallbilled mountain thrush	*Zoothera dauma* +*
Yellowbacked sunbird	*Aethopyga siparaja* +*
Ortolan bunting	*Emberiza hortulana* +*

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19. *HEMIDACTYLUS FLAVIVIRIDIS* RÜPPELL FEEDING ON A GECKO EGG

According to Daniel (1983), and Tikader and Sharma (1992), the northern house gecko (*Hemidactylus flaviviridis* Rüppell) is primarily insectivorous. Occasionally, it is known to become cannibalistic (Daniel 1983).

On April 22, 2000, at about 0730 hrs, a northern house gecko was seen by us on a bathroom wall in D.B.N. Hostel, University of

Rajasthan, Jaipur, with a spherical white egg in its mouth. From its colour, size and general appearance, the egg looked like that of *H. flaviviridis*. The gecko was moving upwards and after about 2.5 m, it broke the eggshell with two or three blows. The empty eggshell was then thrown away. The gecko positioned itself right below the flowing yolk and started licking it up from the lower-most point, gradually moving upwards. While it was licking the yolk, another gecko appeared and approached it, but was chased away. It consumed the entire yolk within seven minutes. The gecko then moved to another wall.

The empty eggshell was *c.* 11 mm in diameter. After watching this strange behaviour, we examined all baths and toilets minutely. Many geckos were seen on the walls. Many eggs of house geckos were also seen below various hideouts in ones and twos. The area was apparently a favourite breeding site of the geckos. The egg was perhaps lifted from one of the clutches from the same locality.

Feeding on gecko eggs by *H. flaviviridis* is an unusual behaviour for this species, hence worth placing on record.

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20. UROPELTID SNAKES AND THEIR PREDATORS

Birds are among the many predators of uropeltid snakes. Rajendran (1985) has reported predation by domestic fowl, turkey, guinea fowl, peafowl, owls and wild pigs on uropeltids exposed by digging earth. We have observed some new predators as described below.

I. The house crow (*Corvus splendens*) was seen to prey on *Uropeltis ellioti* at Matighatta in Hassan district of Karnataka State, on August 15, 1999 at 1440 hrs, in a coconut and areca farm. It had just rained and the soil was wet. We observed the snake crawling on open ground, between the areca palms. A house crow swooped down and pecked at the snake, but did not attempt to take it away. The snake immediately coiled itself around one of the areca palms and tried to burrow into the soil, but the crow did not allow it to do so. When the crow moved off on being disturbed by the crowd of people watching, the snake took the opportunity and disappeared into the soil.

II. Two other instances are from Anaimalai hill ranges, Tamil Nadu.

(a) On August 21, 1998 at 1810 hrs, in the forest fragment of Varatuparai, we observed a Malabar whistling thrush (*Myiophonus horsfieldii*) preying on *Uropeltis ocellatus*. We were sitting among the tea bushes adjacent to a patch of forest, when we saw a snake come out of the soil, near the base of a tea bush (*Camellia thea*). A thrush flew down and sat on a branch of the tea bush, just above the snake, and watched it. A few seconds later, the thrush caught the crawling snake at the mid-body with its beak. It carried the snake into another tea bush and started tearing open the body. All this

while, the snake tried to escape by lashing at the bird with its head and tail, but was unsuccessful. The bird killed and pecked it to pieces, swallowed the smaller pieces and carried off a larger one.

(b) The Puthuthotam estate (10° 20' N and 76° 58' E) is situated outside Valparai, a hill station, which has coffee (*Coffea arabica*) and tea cultivation, and a patch of forest. The forest patch is one of the medium size forest fragments on the Valparai plateau (Kumar *et al.* 1995). The Pollachi-Valparai road passes through the Puthuthotam estate. Accidental killing of animals by vehicles on the road is very high in such patches (Kumara *et al.* 2000 and Vijay Kumar *et al.* in press). During maintenance operations on this road and a roadside drainage system, from August to September 1998, many Uropeltid snakes were killed. Vehicular traffic and domestic fowl killed other snakes as well, that came on to the road. In one hour, domestic fowl were seen to eat up to 5 snakes.

The total number of deaths observed in a 300 m distance dug at Puthuthotam was 67 *Uropeltis ocellatus*, 9 other Uropeltid species and one *Melanophidium punctatum*.

Digging continued in the area, but we saw only one or two animals along a stretch of 100 to 200 m. This indicates a localized distribution of these snakes in clumps. *Uropeltis ellioti* is a common snake in western and southern Karnataka, especially on agricultural land. We have also seen many snakes killed during soil filling in agricultural land.

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21. *LEPTOBRACHIUM SMITHI* MATSUI, NABHITABHATA & PANHA, 1999 (ANURA: MEGOPHRYIDAE), A NEW RECORD FOR INDIA

Leptobrachium smithi Matsui *et al.* (1999) was described on the basis of megophryid anurans from Thailand that were hitherto referred to as *Leptobrachium hasseltii* Tschudi, 1838 (Frost 1985, Taylor 1962, van Kampen 1923, Zhao and Adler 1993: 116). This latter species was once considered widespread, with Java in the Greater Sundas, Republic of Indonesia, as the type locality (Iskandar 1998 for colour photograph; Dubois and Ohler 1998 for review). *L. hasseltii* was reported from Meghalaya State in northeast India by Pillai and Chanda (1979).

A recent collection of *Leptobrachium* from Chandubi in the Mayeng Hill Reserve Forest (25° 48'-25° 55' N, 91° 21'-91° 32' E), altitude *c.* 90 m above msl, and Garbhanga Reserve Forest (55° 26' N, 91° 37'-91° 49' E), both localities within Kamrup district, Assam State, northeast India matches the description of *L. smithi* in the following characters: a moderate-sized species (male SVL 30.2-52.0 mm; n = 8; female SVL

TABLE 1
DATA ON MEASUREMENTS AND OTHER DETAILS OF ADULT *LEPTOBRACHIUM SMITHI* FROM ASSAM

Regn No	Sex	SVL	IMT	Dorsum Tuberculate
CND 7971	F	71.65	2.30	-
CND 7973	M	37.95	1.15	-
CND 7974	M	42.10	1.15	-
CND 7976	M	40.65	1.25	+ (faint at posterior)
CND 7977	M	40.50	1.15	+
CND 6921	M	30.20	1.15	-
GRB 6981	F	59.85	1.70	+
GRB 6982	M	52.20	1.65	-
GRB 6983	M	42.60	1.65	-

Acronyms: F = female; SVL = snout-vent length; IMT = greatest length of inner metatarsal tubercle; - = absence; + = presence. All measurements in mm.

59.85 and 71.65 mm; n = 2; additional details in Table 1); upper half of iris scarlet; small inner metatarsal tubercle (metatarsal tubercle to SVL ratios 0.027-0.039; mean 0.032); dorsum typically smooth (although a third of our sample show faint tubercles on the posterior end of dorsum); white spots on sides of body and on thigh; dark spots on ventrum; absence of dark markings on dorsum; and rows of dermal ridges on dorsal surface of limbs absent. All specimens referred to were deposited in the Zoological Museum, Arya Vidyapeeth College, Guwahati, with the exception of one (ZSI A9135) that was deposited in the collection of the Zoological Survey of India, Kolkata.

We examined another example of this species, collected from the Khasi Hills (ZSI uncat.; detailed sampling data unavailable) that was registered as *L. hasseltii*.

Based on the known distribution of *Leptobrachium hasseltii*, Matusi *et al.* (1999) restricted the species to the Sundas. Therefore, it is inferred that earlier records from India (cf. Chanda 1994, 1995; Dutta 1997) are based on *L. smithi*. We confirm the removal of *hasseltii* from the amphibian fauna of northeast India on the basis of the specimens we report herein. The range extension now being reported suggests the occurrence of *L. smithi* in regions intervening between northeast India and Thailand, especially Myanmar, whose amphibian fauna is poorly known. Indeed, Matsui *et al.* (1999) suspected the occurrence of *Leptobrachium smithi* in the southern part of this country, on the basis of the description of *L. hasseltii* by Annandale (1917).

We thank the Assam Forest Department for permission to conduct herpetological studies in the state, Dr. Shyamal Kumar Chanda, ZSI, for curatorial help and Patrick David, Walter Erdelen and Tony Whitten for literature.

Acronyms used: CND = Chandubi, Mayeng Hill Reserve Collection (Arya Vidyapeeth College Museum, Guwahati); GRB = Garbhanga Reserve Forest Collection (Arya Vidyapeeth College Museum, Guwahati); ZSI = Zoological Survey of India, Kolkata; SVL = snout-vent length.

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22. NOTES ON *TYLOTOTRITON VERRUCOSUS* ANDERSON: A CRITICALLY ENDANGERED NEWT FROM MANIPUR

The newt *Tylototriton verrucosus* was described by Anderson in 1871 from a specimen collected from Yunan region. The species is locally known as Lengva (Tangkhul) and Hangoi mamei panba (Manipuri). It is the only species of tailed amphibian recorded so far from India. Fully mature males measure 145-170 mm, while females measure 150-200 mm. The head is as broad as it is long and has an inverted V-shaped prominent ridge. The limbs are short, with four digits in the forelimbs and five digits in the hind limbs. The tail with its upper margin sharp edged is as long as the head and body together. The legs appear to be weak and their movement on land is sluggish. The body is dark brown above with a tubercle, two rows of porous knob-like prominent glands on either side of the vertebral ridge. Each row has 15-20 glands. The anal opening is a longitudinal slit with a slightly swollen rim. The species does not show sexual dimorphism, but during the breeding season females can be easily recognised by their distended body and swollen vent.

Habitat: Their favourite habitats are pools, ditches, ponds and paddy fields, and they have a habit of hiding under rotten leaves, in rock pools, roots and dead tree trunks near water. They are also found in small streams fringed with vegetation. At the onset of monsoon, they come out of their hiding places to the water for mating. They are active throughout the monsoon until winter sets in. During winter, they hide in the burrows of rats and in other safe places till the next monsoon. The eggs are laid on water bodies and tadpoles hatch out within a few days, maturing within a month or two. The species was found at high altitude where the climate is cold.

Distribution: Nepal, Sikkim, Darjeeling and Arunachal Pradesh. In Manipur, it is found only in Ukhrul and Senapati districts. In the late eighties, this species was abundant in Ukhrul and Mao areas. In Ukhrul district, it used to be found in places like Ngaimu, Pushing, Ukhrul, Hundung, Phungcham, Shihai Shiroi, Khangkhui, and Nungshong. But recent surveys

in these areas show that the species is now much reduced. In Mao area in Senapati district, as reported by the local people, it is hardly seen nowadays.

Tylototriton verrucosus is listed under the Indian Wildlife (Protection) Act, 1972 Schedule I as an endangered species, and also in the Wildlife Protection Act, Manipur Rules 1974 as a protected species. Increasing human demands on forest resources and cultivable land, fishing with chemicals have contributed to the diminishing population throughout its natural habitats in Manipur. It is also eaten by the locals in the area. No effective action has been taken to check the reduction of Lengva in Manipur, and if no attempt is made to preserve the species, this only tailed amphibian will soon become extinct in this State.

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23. NEW RECORD OF CYPRINID FISH *LABEO BATA* (HAMILTON) FROM CHINDWIN DRAINAGE

The fish fauna of Manipur is of great interest as it is drained by two important rivers, the Barak-Brahmaputra and Chindwin-Irrawady systems. The western half of the state is drained by the Barak-Brahmaputra system, whereas the Chindwin-Irrawaddy system drains the eastern half, including the central valley. The Chindwin-Irrawaddy system is entirely separated by high mountain ranges from the watersheds of the Barak-Brahmaputra (Chaudhuri 1919). Chatrickong river is formed by two streams, namely Sanalok and Khunukong. Khunukong originates from the western part of the majestic Shiroi peak and flows southeast to join Sanalok, while Sanalok originates at the foothills of the highest peak Khayangphung (2,833 m) of the district which lies near the Indo-Myanmar border, and flows southwards to meet Khunukong. The river then flows as Chatrickong for about 5 km, and enters Myanmar where it is called Nam Panga (Myanmarese) and flows to the east and then turns southward to meet the Chindwin.

Jayaram (1981, 1999), Talwar and Jhingran (1991) do not mention the availability of this fish from the Chindwin drainage of Myanmar. Jayaram (1981) recorded 26 valid species from southeast Asia. Sen (1985) reported the fish from Assam and the northeastern states of India that include Brahmaputra drainage, but did not mention the specific locality of the collection. Burman (1988) recorded it from Tripura. During our ichthyofaunal collection from 1996-98, five specimens were collected from the Chatrickong river. The species is reported for the first time from Chindwin drainage.

The fish were collected with the help of cast net, side-tracking of rivers and also by 'khaishang' — a unique indigenous method of catching migratory fishes on their way back from smaller hillstreams after breeding. This technique is commonly used in southeastern Ukhrul district in Manipur. The fish were preserved in 10% formaline. The types have been deposited in the Manipur University Museum of Fishes (MUMF).

Material examined: MUMF/1587, 118.1 mm SL, MUMF/1588, 110.4 mm SL, MUMF/1589, 92.6 mm SL, Chatrickong river at Sanalok, 150 km from Imphal, 6.vi.1996; 2 unregistered specimens 98.5-108.2 mm SL, 20.viii.1998, coll. Keishing Selim.

Diagnosis: D. ii, 10; P. i, 13-15; V. i, 8; A. ii, 5-6; L.trs. 6/1/4; L1. 40-41; predorsal scales 14-15. The species is characterised by a lower lip slightly fringed, folded back and joined to isthmus by a narrow bridge; small tubercle above

mandibular symphysis; irregular black blotch present on 4th-6th scales of lateral line.

Colour: Dorsal half of flanks golden yellow; inner half of flanks and belly silvery. An irregular black blotch on 4th-6th scales of lateral line. Faint blotch on caudal peduncle. Pelvic and anal fins dark with orange red tip.

Habitat: Mostly found in the plains course of the river. It moves upstream during the breeding season, which starts from April and returns to the lower course of the river after breeding.

Distribution: India: widely distributed: Bangladesh and Nepal.

Remarks: Talwar and Jhingran (1991) listed 31 species of *Labeo* in the Indian region. However, Jayaram and Dhas revised the genus and listed 28 species in eight complexes (Jayaram 1999). The species is common in the Indian region. In Manipur, about seven species of *Labeo* were found, including *Labeo gunius* and *L. rohita*.

Labeo bata was one of the common species caught in the Chatrickong river during the monsoon. During the breeding season, the fish moves in shoals upstream. It is esteemed in the region for its taste and is highly priced.

The fish migrate upstream from April to July and return from August to November. In other seasons, it was not present, as reported by fishermen. Being a migratory fish, it is mostly caught by 'khaishang', an indigenous technique practised in the region for catching migratory fishes. In the absence of specimens from the river system in Myanmar, study of fishes from the Chindwin headwaters of the Ukhrul district gives a picture of the Chindwin fauna. *Labeo bata* is recorded for the first time from the Chindwin drainage. As it migrates from the Myanmar side to the waterheads of Chindwin drainage, it is likely that it may also be distributed in Myanmar.

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24. A NEW REPORT OF *HORABAGRUS BRACHYSOMA* JAYARAM, FAMILY BAGRIDAE IN UTTARA KANNADA DISTRICT, KARNATAKA

(*With one text-figure*)

The catfish *Horabagrus brachysoma* Jayaram, Family Bagridae, has been reported in the Kerala Western Ghats. It was first described as *Pseudobagrus brachysoma* by Gunther in 1864, and by Day in 1865 (*Proc. zool. Soc. Lond.* p. 290, Malabar, ii, p. 185, pl. xiii, fig. 2), from Cochin as *Pseudobagrus chryseus*. In later publications, Day (1889) refers to it as *Macrones chryseus*. The species of the genus *Macrones* are identical to the Indian species of *Mystus*. They are characterised by the presence of 15 or less anal fin rays, eyes placed much above the angle of the mouth (invisible from the ventral surface), barbels longer than head, the pelvic fin far from the anal fin, and a moderately long adipose fin. On the other hand, *M. chryseus* is characterised by the presence of an anal fin with 26-28 rays, the eyes being placed in line with the angle of the mouth so that it is visible from the ventral surface, the barbels not extending beyond the head and the pelvic fin reaching the anal fin.

Because of these anomalies, *M. chryseus* was separated from the *Mystus* group and for some time, it was placed in the genus *Pseudobagrus* as *P. brachysoma* (Jayaram 1952). *P. brachysoma* is the only species of the genus from the Indian subcontinent, while the other species of the genus are Chinese. A comparison of specimens of *P. brachysoma* with other specimens of *Pseudobagrus* showed that they are not congeneric, so *P. brachysoma* was given a new generic rank and named as *Horabagrus* (Jayaram 1955).

The species *Horabagrus brachysoma* has a moderately elongated, compressed body with a large head and a wide subterminal mouth. The eyes are large, inferior and visible from the ventral side. The dorsal fin, consisting of the rayed fin with 5-7 rays, possesses a hard spine and is separated from the softer smaller adipose dorsal fin. It also has four pairs of barbels: one nasal, two mandibular and one maxillary. (Jayaram 1981)

This species has, till date, been reported from Neyyatinkara backwaters (near Trivandrum), its southernmost limit, to regions near the Karnataka border, the northernmost limit.

Field surveys were conducted in the river systems of Uttara Kannada district, located in northern Karnataka. Uttara Kannada (13° 52' to 15° 30' N and 74° 5' E), forms part of the northern extent of the Western Ghats (Fig. 1). This region has many perennial and temporary streams and rivers. The fish diversity of the four main west flowing rivers, Sharavati, Aghanashini, Bedti and Kali, were studied. Collections were made using gill nets, cast nets and drag nets. Samples were collected from six sites in each of these four rivers from January 1997 to January 1999.

During a recent survey, fresh samples of *Horabagrus brachysoma* have been collected at the rivers Kali and Aghanashini near the downstream reaches of these river systems. The species (*H. brachysoma*) in the River Kali was first recorded at Kadra (74° 20' E, 14° 53' N, about 100 m above msl). The habitat at this site consists of smooth flowing runs, the riparian vegetation here is mostly composed of long stands of bamboo and species of *Terminalia*. The site at Kadra is very close to the Kaiga Dam Project and forms part of the reservoir. As a result, the water here is regulated. Local villagers revealed that the species is found in this region, but is rarer than other Bagrids. The first collections were made in March 1998. In April 1998, we

Fig. 1: Map of the study area, Uttara Kannada District, Karnataka

collected one more specimen from the downstream reaches of the river Aghanashini at Hulidevarakodlu (74° 40' E, 14° 24' N, about 500 m above msl). The River Aghanashini is subjected to much less human disturbance than the River Kali. The study area near Hulidevarakodlu is pristine, with thick evergreen forests of *Terminalia*, *Eugenia hyneana*, *Callophyllum* spp., *Mangifera indica*, and *Pongamia* forming the riparian vegetation.

Two more specimens were collected in January 1999, one at the same site on the River Kali (at Kadra) and one at Kirtigadde (74° 36.5' E, 14° 26' N, about 500 m above msl), 1 km downstream of Hulidevarakodlu. The morphometric details of the specimens are given in Table 1.

Horabagrus, listed as endangered, has been recorded earlier only in Kerala. This report on the presence of *Horabagrus brachysoma* in Uttara Kannada is important since it extends the known geographical range from Kerala to regions much further northwards along the Western Ghats. Though it has not yet been reported from southern Karnataka, our findings suggest the possible occurrence of the species all along the hill streams of the Western Ghats.

TABLE 1
MORPHOMETRIC DETAILS OF THE SPECIMENS (IN CM)

Parameter measured	Specimen from Kadra	Specimen from Kirtigadde	Specimen from Kadra
Total length	14.4	19.9	21.2
Standard length	11.8	16.2	17.4
Head length	3.2	4.2	4.8
Body depth	3.1	4.5	5.2
Length of snout	1.2	1.9	2.1
Eye diameter	0.65	0.9	1.0
Interorbital distance	1.8	2.6	3.0
Length of barbel:			
nasal barbel	1.6	2.1	2.3
maxillary barbel	2.1	2.8	2.4
outer mandibular barbel	2.2	25	2.6
inner mandibular barbel	1.2	1.7	1.8
Predorsal distance	4.2	6.4	6.5
Postdorsal distance	7.8	9.5	11.2
Distance from pectoral fin base to pelvic fin base	3.9	4.2	4.5
Distance from pelvic fin base to anal fin base	1.0	1.4	11.4
Length of caudal peduncle	1.6	2.3	2.2
Height of caudal peduncle	1.3	1.9	2.0
Height of dorsal fin	1.8	3.6	3.7
Length of pectoral fin	2.5	3.1	3.6
Length of pelvic fin	1.5	2.1	2.2
Length of anal fin	2.8	4.1	4.6

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25. RANGE EXTENSION OF *MYSTUS BLEEKERI* (DAY) TO THE FRESH WATERS OF TAMIL NADU AND NOTES ON ITS CONGENERS IN TAMIL NADU AND SRI LANKA

Day (1875-78) named the specimens from River Hooghly, Calcutta *Macrones bleekeri* (now *Mystus bleekeri*) which Bleeker in 1853 had identified as belonging to the species *keletius* (Valenciennes, 1839: type locality - Pondicherry). Though both the species bear lateral stripes on the body, they differ in several characters. In *bleekeri*, the occipital process is twice as long as broad and reaches the basal bone of dorsal; adipose dorsal base is long, commencing just behind last dorsal ray, its base being 2.4 times the rayed dorsal; maxillary barbels are long, reaching the anal fin, whereas in the latter, the occipital process is narrow, being 3 times as long as broad at the base and does not reach the basal bone of dorsal; adipose dorsal base is shorter being 1.1 times the rayed dorsal base, with wide interdorsal space; maxillary barbels are shorter, reaching only the middle of pelvic fin (Day, op. cit.; Misra 1976). *M. bleekeri* (Fig. 1) also differs from the widely distributed striped catfish *vittatus* (Bloch 1797) by its longer adipose dorsal and less number of gill-rakers on the lower arm, 9-11 vs. 22-27 (Sharma and Dutt 1983).

The distribution of *bleekeri* is stated to be north India, with Mahanadi as its southern limit (Menon 1999; Jayaram 1999). However, Sharma and Dutt (op. cit.), reported it from peninsular India (Andhra Pradesh: Guntur). Recently, the species was reported from Neyyar river in Thiruvananthapuram district, Kerala by Raju *et al.* (1999), and Ponmudi, also in the same district (Cherian *et al.*, in press).

This report is based on collections made during paddy field ecosystem studies by the third author. Ten specimens ranging in length from 59 to 122 mm SL were collected during May-October 1999, from Singaperumal Koil paddy field in Chengleput district. This extends its distributional range to Tamil Nadu.

Jayaram (op. cit.) listed 19 species of *Mystus* from the Indian subcontinent, of which, with the recent inclusion of *microphthalmus* (Day) from Manipur, 14 species are represented in Indian territory. With the exception of this

species and *tengara* (Hamilton) [*tengara* has been synonymised with *vittatus* by Sharma and Dutt (op. cit.), but kept separate by Menon (op. cit.) and Jayaram (op. cit.)], all the remaining 12 species are known from peninsular India. Of these, four species namely *krishnensis* Ramakrishnaiah, *malabaricus* (Jerdon), *oculatus* (Valenciennes) and *punctatus* (Jerdon) are endemic to the Peninsula, mostly restricted to the hill streams of the Western Ghats. With the recent addition of *malabaricus* from the Indira Gandhi Wildlife Sanctuary, Anaimalai Hills, and the present addition of *bleekeri* from the fresh waters of Chennai, nine species are recorded from Tamil Nadu. It is worth mentioning here that *montanus* (Jerdon), recently reported from Javadhi Hills of Eastern Ghats (Rema Devi, 1992), is also found in the Tamil Nadu part of the Anaimalais, Western Ghats.

Three species of *Mystus*, namely *gulio*, *keletius* and *vittatus* (Deraniyagala 1952; Pethiyagoda 1991) are known from Sri Lanka. However, there seems to be some discrepancy in the record of *keletius* in Sri Lanka. Though the figure accompanying the description in Munro (op. cit.) is that given by Day (op. cit.), the description of adipose dorsal fin is a feature typical of *cavasius*. Besides, for several other characters given, the range covers both the species. However, the photograph captioned as *keletius* (p. 150), accompanying the description by Pethiyagoda (op. cit.) is that of *cavasius*. Also, as evidenced by the same photograph, *cavasius* is characterised by a long, adipose dorsal commencing immediately after the rayed dorsal, which is triangular, long and pointed, with a concave margin; smaller head, deeper body and absence of lateral stripes, whereas *keletius* has a smaller adipose dorsal, with a wide interspace between it and the rayed dorsal, which is low and with a somewhat rounded margin. Other known differences are: the number of branched rays in the pectoral and anal fins, the maxillary barbel length and body proportions.

Day (op. cit.) originally reported *keletius* from Sri Lanka, which has been followed by subsequent workers. Pethiyagoda (op. cit.) in his description of the species (p. 149) lists *cavasius* as one of the names applied to it in Sri Lanka probably because of "confused identity". He also mentions that it attains a length of 18 cm, whereas it is known from literature that *keletius* is a smaller species, reaching only 12 cm in length. From the photographs of the Sri Lankan species it is certain that *cavasius* is present in Sri Lanka. It is also inferred that, including *cavasius*, four species are known from Sri Lanka (overlapping characters of both the species given in literature), and if *keletius* is a mistaken identity for *cavasius*, then three species *cavasius*, *gulio* and *vittatus* are present. Interestingly, these three species inhabiting swampy lowlands are very widely distributed in the Indo-Malayan region. None of the hill stream catfish in India are represented in Sri Lanka.

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Editor's Note: With reference to the note Thomas K.P. *et al.* (1999): Additions to the fish fauna of Pambar River, Kerala, Vol. 96(2) it has been pointed out by Dr. K. Rema Devi that there is a variation in the scalation of the middorsal streak in *Garra hughi*, which has been overlooked by the authors. Also, *Horalabiosa joshuai* as already been reported from Kerala (Rema Devi, K. & A.G.K. Menon (1994), *Rec. zool. Surv. India*, 94(2-4): 247-251).

26. RESOLUTION OF THE CONTROVERSIAL WESTERN LIMIT OF THE RANGE OF *DELIAS ACALIS* GODART (LEPIDOPTERA: PIERIDAE)

The western limit of the distribution of the Redbreast Jezebel *Delias acalis pyramus* Wallace has been the subject of some controversy. Evans (1932) gave a range of Shimla (Himachal Pradesh) to Burma (=Myanmar). Subsequent authors, including Wynter-Blyth (1957) and Lewis (1973) gave a range of Nepal to Assam, Burma, Malaysia and the Eastern Ghats of India for the species.

Wynter-Blyth (op. cit.) noted "Evans (op. cit.) gives Shimla as a locality for this butterfly, but this is not confirmed by THE FAUNA OF BRITISH INDIA nor has the author any record of its capture there. If his record is correct, it will presumably also be found in Garhwal and Kumaon."

Recently, I have seen this butterfly on five occasions in Kumaon. The first time was on November 9, 1997 in a garden in the H.M.T. Colony in Ranibagh near Haldwani at an elevation of approximately 450 m. The butterfly was attracted to poinsettia blooms (*Euphorbia pulcherrima* Willd. ex Klotzsch) and settled for over a minute, allowing itself to be observed well. However, it was not possible to observe the *recto* surface and the diagnostic red basal area on the hindwing *recto*. It might therefore have been the Redbase Jezebel *Delias pasithoe* L., although this is unlikely.

The next sighting was in Jones Estate in the Bhimtal valley on April 21, 1998 at an elevation of 1,500 m. A rather worn specimen was attracted to blossoms of *Bauhinia vareigata* L. By a stroke of luck, it sailed across a terrace below me, so it was possible to clearly see the red basal area on the hindwing *recto*. It was certainly *Delias acalis*.

The third sighting was 10 km north of the town of Rudrapur in the Terai, at an elevation of

c. 450 m on March 7, 1999. The specimen was seen flying about at tree top level in the manner typical of the genus. It crossed the road occasionally, but did not settle. Again, it might have been either *acalis* or *pasithoe*, since the *recto* surface was not visible from below.

The fourth specimen was a female that settled on a flowering buddleia bush (*Buddleja* L.) on March 9, 1999 in Jones Estate, within a hundred metres of where the second individual was sighted nearly a year before. The specimen is now in my collection. The forewing length is 43 mm and the expanse 90 mm. This is the first specimen recorded from Kumaon, and is in good condition.

The fifth record was on December 1, 1999 when an individual was flying along the motor road 200 m from where the first record was sighted in Ranibagh in 1997. Since it was flying slowly, it was possible to see the diagnostic red basal patch on the hindwing *recto*.

I am quite certain that this species was not present in this area during the last 20 years and my late father did not record it either in the course of collecting and observing butterflies in the area since 1949. It is such a conspicuous butterfly that it could not have been overlooked, even by a casual collector.

Therefore, it has moved into the area recently. Three definite and two probable records within three years, where it was not recorded for over 50 years, implies that the recent records are members of a breeding population rather than mere stragglers from Nepal. The sightings follow the emergence pattern observed by Bailey (1951) in Nepal, i.e., November-December; March-April and again the following March and December. Although the monsoon brood noted by Bailey (op. cit.) has not been recorded in Kumaon so far, this is probably because of the limited period of activity of butterflies during the monsoon, as well as because I hardly travel to low elevations during that season. If one considers that this species is not a known migrant, nor for that matter is any Indian member of the genus, the possibility of the present records being merely stragglers is unlikely. I might add that during the 1980s and early 1990s, I was on the road much more often to Haldwani and other adjoining low areas than during the later 1990s, hence the possibility of encountering these butterflies was greater in the past than during the last few years when they have actually been recorded.

According to Sevastopulo (1973), the larval hostplant is probabl· *Loranthus* L., of which four species occur below 1,500 m in Kumaon (Osmaston 1927).

The above observations resolve the problem of Evans' (op. cit.) record of the butterfly from Shimla. Being at the western extremity of its range, this limit is evidently flexible. The factors influencing the expansion and contraction of its range have not been understood, but in certain years, such as during 1997, 1998 and 1999, the range is extended westward. For most of the 20th century, this butterfly was unable to extend its range west of Nepal. But now, factors being conducive, it has extended its range to Kumaon and possibly even further westward along the Himalaya. The material upon which Evans (op. cit.) based his record from Shimla was evidently a part of such an expansion in range as is being witnessed at present. One or more specimens were taken at Shimla, in much the same manner as the specimens reached Jones Estate recently. Subsequently, the range contracted and no more records were forthcoming, hence the controversy.

There is also a controversy regarding the occurrence of this butterfly in the Eastern Ghats where it is said to be very rare (Wynter-Blyth, op. cit.). According to Evans (op. cit.), the subspecies *kandha* Doherty occurs in the Madras Presidency. Alan Sharman (*in litt.*), who collected and lived in the Eastern Ghats until the 1960's failed to find it there. Other recent

workers have also not found it. Perhaps the factors leading to the recent expansion of this insect's range westward along the Himalaya will also cause it to be met in the Eastern Ghats, too.

For the future, it would be best to amend the distribution of this butterfly to read "Extends its range westward along the Himalaya in certain years from Nepal to Kumaon and probably as far as Himachal Pradesh."

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March 2, 2000 PETER SMETACEK
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27. AMERICAN JOINTVETCH *AESCHYNOMENE AMERICANA* LINN. — A NEW LARVAL FOOD PLANT OF *TERIAS HECABE* LINN.

While working on the butterflies of the Sanjay Gandhi National Park (SGNP), Mumbai, we came across a plant with a glandular hispid stem. At first, it appeared to be an insectivorous plant. We collected and identified it as *Aeschynomene americana* Linn. The Common Grass Yellow butterfly *Terias hecabe* Linn. lays eggs on this plant. We also collected a caterpillar feeding on the plant. The caterpillar pupated later, and the butterfly that emerged was identified as *Terias hecabe* Linn.

Aeschynomene americana (Linn.), commonly known as sensitive plant or American jointvetch, is a native of tropical America (Maheshwari and Paul 1975) and was introduced into India recently. It was first reported from Hazaribagh (Chatterjee 1960) and subsequently near Ranchi (Maheshwari and Paul 1975), both in Bihar State. Chandrabose and Srinivasan (1976) have reported this species from Kerala, Quilon district, Perundanaruvi. However, according to them it is a native of the West Indies. In the FLORA OF MAHARASHTRA, Almeida (1999) has mentioned that the species has so far been collected from Thane and (the erstwhile) Colaba districts of Maharashtra. The present record is from Goregaon (East), in the vicinity of the SGNP. It is interesting to note that this intruder has come closer to the National Park area as the earlier distribution as recorded in the FLORA OF MAHARASHTRA is Khopoli and Vashi areas. Unless precautions are taken, it will become a major intruder into the area and disturb the growth of the native flora. I (NC) have observed that *Hyptis suaveolens*, commonly known as vilayati tulsi, has become a major threat to low growing plants like *Smithia sensitiva* and *Cassia tora*, *Cyanotis* and *Commelina* spp. which once grew profusely. However, both these plants i.e. *Aeschynomene americana* and *Hyptis suaveolens* are useful to butterflies, as the former is a new larval food plant for the Common Grass Yellow and the latter a source of nectar for many butterflies.

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28. MIGRATION OF THE COMMANDER BUTTERFLY *LIMENITIS PROCRIS* (CRAMER)

In the forenoon of November 5, 1999, the first author (NC) observed a Commander Butterfly feeding on flowers of *Ixora* outside Hornbill House. I waited for some time to see whether the butterfly was in the vicinity and would return to feed on these flowers. However, there was no trace of the butterfly till evening. Subsequently, in the third week of November, I saw two of these butterflies feeding on *Lantana* flowers near Churchgate Station, Mumbai.

On November 25, 1999, one of us (VG) collected a caterpillar of the butterfly from a kadamb tree *Anthocephalus cadamba* growing within the boundary of Hornbill House. The caterpillar pupated on November 25, 1999 and the butterfly emerged on December 3, 1999. On a closer look at the kadamb tree, we found three more caterpillars, which were 3rd instars and pupated on December 12, 1999.

Earlier, a BNHS member, Mr. Kiran Srivastava informed us about the sighting of a Commander butterfly near Colaba Woods on December 28, 1998. According to him, the butterfly seemed to have escaped from a predator, as the right hindwing was completely missing.

I have been monitoring butterfly migration in Mumbai and its vicinity over the last 10 years and have not come across the Commander butterfly in the city area. According to Wynter-Blyth (1957), this butterfly is a denizen of, though not exclusively confined to, thickly forested areas receiving heavy or moderate rain at an elevation of 305 to 1,220 m

It is interesting to note their presence in an urban built up area with heavy vehicular traffic. As these butterflies are seen only for a short time, they were possibly on migration. Though many Nymphalids are known to migrate, Williams (1930) does not mention this butterfly.

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29. DIVERSITY OF BUTTERFLIES NEAR A POOL IN THE SANJAY GANDHI NATIONAL PARK, MUMBAI

Along with three others, I visited the Sanjay Gandhi National Park (SGNP), Mumbai, on December 5, 1999. We had planned to sit near a shallow pool created by a natural dyke on the adjoining BNHS land. Apart from this pool, most of the streams and puddles in the area dry out by November end. The water body, approximately 12 sq. m in area and one metre in depth, is situated on a rocky bed at the base of a valley. The surrounding hills rise about 15 m above the pool. The neighbouring forest is tropical, moist, semi evergreen, typical of SGNP. Although the stream is dry, the pool is fed by ground water that trickles through cracks in the adjoining rocks, forming a wet patch of *c.* 4 sq. m, that is coated with algae and moss. The terrain in the immediate vicinity is rocky, topped with a carpet of dry leaves of *Bombax ceiba*, *Garuga pinnata* and *Pongamia pinnata*. This leaf litter ensures that the moisture stays trapped even during the hot hours of the day, inviting a variety of Lepidoptera.

We reached the site at 0900 hrs and stayed till 1115 hrs. In this short span of time, 35 species of butterflies belonging to five families visited the wet portion surrounding the pool, for mud-puddling. The butterflies landed directly on the wet patch or on the surrounding leaf litter.

I have been visiting SGNP for over a decade, but have never seen such a diverse gathering of butterflies at a single site. Among the most abundant species were the Commander, Common Leaf Blue, Common Sailor, Chocolate Pansy, Common Leopard, and Psyche (more than 15 individuals each), while the least common were the Gaudy Baron, Silverstreak, Common Silverline, Longbanded Silverline, Grey Pansy and Common Hedge Blue (one each).

Butterflies observed at SGNP:

Papilionidae (Papilioninae)

1. Common Mormon (*Princeps polytes*)

Pieridae (Pierinae)

2. Psyche (*Leptosia nina*)
3. Pioneer (*Anaphaeis aurota*)
4. Common Wanderer (*Pareronia valeria*)
5. Yellow Orangetip (*Ixias pyrene*)
6. Great Orangetip (*Hebomoia glaucippe*)

Pieridae (Coliadinae)

7. Common Emigrant (*Catopsilia pomona*)
8. Three Spot Grass Yellow (*Eurema blanda*)

Lycaenidae (Theclinae)

9. Common Leaf Blue (*Amblypodia anita*)
10. Silverstreak (*Iraota timoleon*)
11. Common Silverline (*Spindasis vulcans*)
12. Longbanded Silverline (*Spindasis lohita*)

Lycaenidae (Polyommatinae)

13. Opaque six-line (*Nacaduba beroe*)
14. Common Cerulean (*Jamides celeno*)
15. Pea Blue (*Lampides boeticus*)
16. Dark Cerulean (*Jamides bochus*)
17. Common Pierrot (*Castalius rosimon*)
18. Grass Jewel (*Zizeeria trochilus*)
19. Common Hedge Blue (*Acetolepis puspa*)

Nymphalidae (Styrinae)

20. Dark Brand Bushbrown (*Mycalesis mineus*)

Nymphalidae (Nymphalinae)

21. Common Leopard (*Phalanta phalantha*)
22. Chocolate Pansy (*Precis iphita*)
23. Lemon Pansy (*Precis lemonias*)
24. Grey Pansy (*Precis atlites*)
25. Great Eggfly (*Hypolimnas bolina*)
26. Common Sailor (*Neptis hylas*)

27. Common Sergeant (*Parathyma perius*)
28. Commander (*Moduza procris*)
29. Red Baron (*Symphaedra nais*)
30. Gaudy Baron (*Euthalia lubentina*)

Nymphalidae (Danainae)

31. Common Crow (*Euploea core*)
32. Plain Tiger (*Danaus chrysippus*)
33. Glassy Tiger (*Parantica aglea*)
34. Blue Tiger (*Tirumala limniace*)

Hesperiidae (Pyrginae)

35. Small Common Flat (*Sarangesa dasahara*)

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30. SOME OBSERVATIONS ON LARVAL AND PUPAL DIMORPHISM IN THE COMMON NAWAB BUTTERFLY (*ERIBOEA ATHAMUS*)

The life cycle of *Eriboea athamus* has been studied by T.R. Bell (1909). The variations observed in the larval and pupal coloration during my studies on this species are given below.

Egg: According to Bell (1909), the butterfly lays its eggs only on the upper side of the *Acacia* spp. leaf in a sunny place. I noted that the eggs were laid on both the upper and lower surfaces of the leaflet. About five eggs were laid on each plant. The eggs hatched after 4 days and measured about 0.1 mm in diameter.

Larva: When the larva has just hatched, it is pale, transparent yellowish-brown in colour, measuring about 0.4 mm in length with a dark, coffee brown head bearing four minute horns. Within four hours of hatching, the colour starts turning light green as they start feeding on the *Acacia* leaves.

Two types of larval coloration were observed. In the first type, segments 4-11 had a yellow band, unlike the white one described by Bell. Again, the broad bands on segment 6, 8 and 10 are yellow, bordered anteriorly with black, while Bell observed white bands with a black anterior border.

The second type had three broad, dark yellow bands on segments 6, 8 and 10, bordered by a black band. Also, the narrow, horizontal yellow band on segment 3 had a black outline. Thin yellow lines alternated with the yellow bands.

Pupa: Similarly, dimorphic forms of pupa were observed. Bell (1909) recorded yellow or light green pupa, with white stripes, spots and bands. The pupa of the first type of caterpillar observed was light green, whereas the pupa of the second type was dark green with prominent white spots, bands and lines. In both cases, none of the pupae were yellow.

Habits: The resting habit of the larva has been observed by Bell (1909) "When the larva grows too large for one bed, it makes another, soon requiring 3 or 4 or more leaflets to rest upon". During the present study, it was observed that the larva never needed another leaflet to rest upon. It remained on the same leaflet until pupation. According to Bell (1909), it returns to the same silk bed after feeding. Another interesting habit observed in the caterpillars reared in captivity was that they removed their own faecal pellets with their mouth, if the pellet came in the way, or if it was still attached to the anal region. When teased it moves with a halting motion spreading abundance of silk (Bell 1909).

The feeding habit of the larva is different. It begins feeding on a single leaflet eating on one sub-leaf of a leaflet. It starts at the nodal end of the sub-leaf, returning just above the same position till the sub-leaf is completely eaten or becomes "sickle shaped"

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31. OCCURRENCE OF *PSECHRUS ALTICEPS* POCOCK (ARANEAE: PSECHRIDAE) IN WESTERN GHATS, KERALA WITH A REDESCRIPTION AND NOTES ON ITS HABIT AND HABITAT

(*With one text-figure*)

Psechridae is one of the less studied families of Araneae. Till the seventies, only two species, *Psechrus alticeps* Pocock and *Fecenia travancoria* Pocock were recorded from India. Later, Tikader (1977) described *Psechrus nicobarensis* from Andaman and Nicobar Islands. Though the family does not show much species diversity, it is one of the most common spiders in the forests of Ernakulam district in Kerala. In the FAUNA OF BRITISH INDIA Pocock (1900) gives only a brief description of the species, which we found to be highly inadequate for identification. Hence a redescription of *Psechrus alticeps* Pocock is attempted here, with notes on its habit and habitat. Earlier, it was reported from Trivandrum (Ferguson 1906) and Cochin (Gravely 1922). We extend its distribution to three new areas in Kerala: Bhoothathankettu, Thattakkad Bird Sanctuary and Munnar.

Psechrus alticeps Pocock
(Fig. 1a-g)

1899. *Psechrus alticeps* Pocock, *J. Bombay nat. Hist. Soc.* 12: 751

1900. *Psechrus alticeps* Pocock, *Faun. Brit. India, Arachnida*: 211

Specimens examined: 4 ♀♀, 1♂, Bhoothathankettu 3.iv.2000; 3 ♀♀, Thattakkad Bird Sanctuary 5.i.2000; 2 ♀♀, Munnar 3.ii.2000, Habitat: Moist evergreen forest, Coll: K. Sunil Jose.

Cephalothorax: Longer than wide, cephalic region highly elevated, with posterior region flat and low. Carapace broader posteriorly. Eyes encircled by black base. Ocular quadrangle longer than wide. Eyes of posterior row recurved and anterior row procurved. Laterals larger than middle eyes in the anterior row, while in the posterior row, eyes more or less equal in size. Space between two rows of eyes broad. Clypeus moderately high. Chelicerae dark brown, strong, provided with boss, armed apically with four teeth on the inner margin and three teeth on the outer margin. Lateral sides of carapace bears a broad, longitudinal, yellowish patch with midregion of carapace darker. Fovea longitudinal, deep, situated posteriorly. Sternum heart shaped, clothed with fine hairs. Legs markedly long, slender, hairy with transverse bands. First leg nearly six times the length of carapace. First leg longer than other legs, third leg the shortest. Leg formula 1423. Tibia of first leg bears three pairs of ventral spines. Male palp as in Fig 1g.

Abdomen: Elongated, subcylindrical,

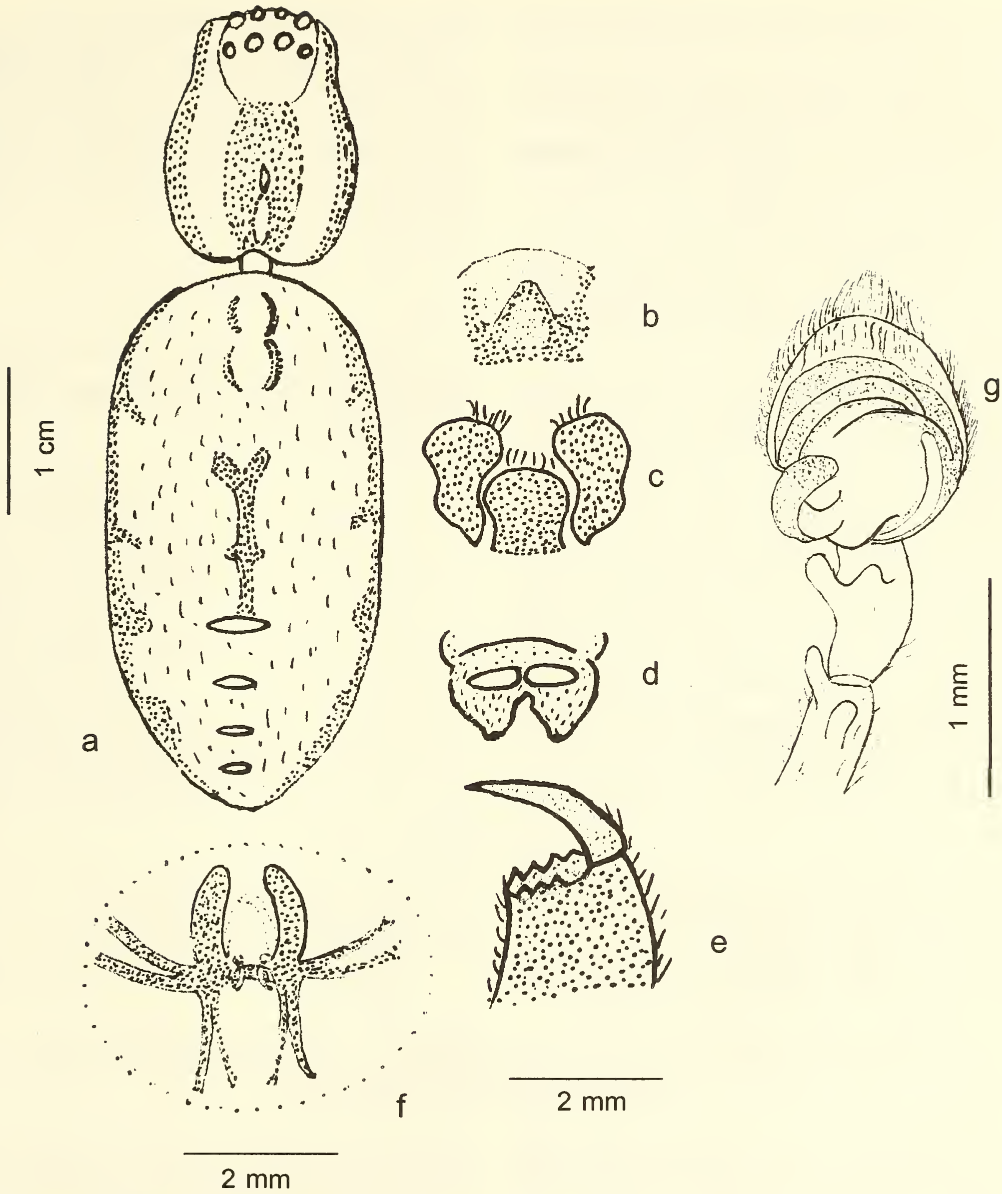

Fig. 1: *Psechrus alticeps* Pocock: (a) Dorsal view of the female, legs omitted, (b) Epigyne, (c) Labium and maxillae (d) Cribellum (e) Chelicerae (f) Internal genitalia (g) Male palp.

clothed with fine hairs. Broadest at the middle, narrows posteriorly. Dorsal surface usually yellowish to dark brown with posterior area darker. In younger individuals, dorsum of abdomen variegated with black patches laterally. Ventral surface uniformly brown except a conspicuous midventral longitudinal white line. Cribellum large, divided transversely as in

Fig. 1d. Epigyne and internal genitalia as in Fig. 1b and 1f.

Measurements (in mm): Total length 24, Carapace 10 L & 7 W; Abdomen 15 L & 9 W. Legs I: 55, II: 45, III: 32 & IV: 46. Measurements (in mm) of original type: Total length 15, Carapace 6.5 L, and Leg I: 49 L.

Distribution: INDIA, Kerala: Ponmudi and Trivandrum (Ferguson 1906); Cochin (Gravely 1922), Bhoothathankettu, Thattakkad Bird Sanctuary, Munnar.

Habit and Habitat: *Psechrus alticeps* Pocock is a large, diurnal spider, spinning large sheet-like horizontal webs of 30-60 cm diameter. The spider remains upside down below the web, which is constructed among herbs or dark hollows at the base of large forest trees. It seems to prefer dark, shady and cool areas for web construction. The spider is very agile and escapes into the safety of its retreat at the slightest disturbance, which makes it very difficult to catch. Sometimes aggregates of many webs can be seen. Young individuals are more yellowish in colour, while older ones are usually more dark brown. Unlike those of Araneidae, the web of *P. alticeps* is usually untidy, with many irregular threads below the sheet. It is permanent, not reconstructed each day. This species has not been reported from outside Kerala, the moist evergreen environment of which is presumed to be required for its survival.

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32. TAXONOMIC STATUS OF THE BOMBAY LUGWORM, *ARENICOLA* (ANNELIDA: POLYCHAETA)

In 1951, Mr. R.G. Dandekar, then Junior Research Assistant at the Taraporevala Aquarium, collected lugworms (*Arenicola*) at Haji Ali bay (opposite the race course, near present Shiv Sagar) off Darya Mahal, the palace of the erstwhile Maharaja of Gwalior.

As he was transferred to another post in the Fisheries Department, he could not follow up on publishing his findings, and Mr. M.R. Ranade, then Senior Research Assistant at the Aquarium, published a short note (Ranade 1952). It is surprising that Ranade claimed that he had "discovered well-developed specimens of *Arenicola*...".

It appears that, around the same time or a little later, Dr. K.K. Nair of the Wilson College also collected specimens from the same locality (Dr. S.P. Karmarkar, *pers. comm.*).

Subsequently, P.V. Wagh, a student of this college started visiting the Taraporevala Marine Biological Station (attached to the Taraporevala Aquarium and affiliated to the University of Bombay) to meet one of his colleagues who was doing her postgraduate work there. PVW and MRR joined hands and the former dissected specimens of *Arenicola* collected by Dandekar.

The two, in association with Dr. H.G. Kewalramani, then Curator of the Aquarium published a paper to the effect that the *Arenicola* of Bombay was a new species, and named it *A. bombayensis*. Prior to publication, the three had asked Dr. G.P. Wells, an authority on *Arenicola* species of the world (Wells 1955), for his comments. Despite Wells' opinion (G.P. Wells *pers. comm.*) that the morphological characters of the Bombay *Arenicola* were not significantly different enough to warrant creation of a new species, they went ahead and created a new species.

The Bombay *Arenicola* resembles *Arenicola cristata* Simpson in having 17 chaetiferous segments, 11 pairs of gills, and the first pair of nephridia being situated on the fifth segment. The only difference is that *A. cristata* has six pairs of nephridia, while the Bombay *Arenicola* has seven, and that the Bombay *Arenicola* had (according to Kewalramani *et al.* 1959) many statoliths while *A. cristata* has only one inside a closed statocyst.

Kewalramani *et al.* (1959) based their arguments on Berkeley and Berkeley's (1939) contention (for B. and B.'s creation of their new species *A. glasseli*), namely "the smaller size (of the sexually mature individuals), the presence of only 16 setigerous segments and 10 pairs of branchiae and particularly, the presence of seven pairs of nephridia, all of which are constant in the material, seem to sufficiently differentiate it from *A. cristata* to necessitate the establishment of a new species."

The creation of Bombay *Arenicola* as a new species rested mainly on Wagh's dissection where it was claimed that the statocyst in the new species consisted of many statoliths, whereas *A. cristata* and *A. glasseli* (related species) had a single statolith. Subsequent dissections of specimens of Bombay *Arenicola* have, however, shown that it has a closed statocyst with a single statolith and that Wagh must have, inadvertently or otherwise, crushed the statocyst so as to find many statoliths.

In view of these subsequent findings that both the Bombay *Arenicola* and *A. cristata* have a closed statocyst with a single statolith, the only difference between the two species is that the number of nephridia in the Bombay *Arenicola* is seven pairs, against six pairs in *A. cristata,* indeed a minor one. *A. glacialis* Murdoch too resembles these two species in having 17 chaetiferous segments and 11 pairs of gills, but differs in having an open statocyst with many statoliths and with six pairs of nephridia, the first pair being on the fourth segment. *A. glasseli* Berkeley and Berkeley, while resembling *A. cristata* in having a closed statocyst with a single statolith and with seven pairs of nephridia, of which the first pair is on the fifth segment, differs in having only 16 chaetiferous segments and 10 pairs of gills. It is therefore felt that *A. bombayensis* does not have the status of a separate species and is, in fact synonymous with *A. cristata*.

Authors' Note.- Our findings and conclusions are based, apart from study of material examined subsequently, on first-hand observation as one of us (BFC) was at the Taraporevala Aquarium from 1951 to 1965, while SRS is an ex-student of Wilson College.

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33. ECOLOGICAL DISTRIBUTION AND POPULATION STRUCTURE OF MUD DWELLING *EDWARDSIA* (CNIDARIA: ACTINARIA) IN A MANGROVE HABITAT OF COCHIN AREA, KERALA

Mangrove areas are a characteristic coastal ecosystem in tropical and subtropical regions and the intertidal zone of this dynamic ecosystem supports a variety of animals such as molluscs, crustaceans, polychaetes and other taxonomic groups. Cochin mangroves are located along the lower part of the Cochin estuary (9° 52'-10° N and 76° 15'-76° 22' E). Most of the available information on the genus *Edwardsia* is descriptive (Athalye and Gokhale 1998), while details of the distribution pattern and population structure are scarce. The present paper describes the ecological distribution and abundance of a burrowing sea anemone *Edwardsia* sp. from the intertidal areas of the mangrove ecosystem in Guntu Island, Cochin.

A well established fringing mangrove area located in the lower reaches of the Cochin estuary was selected for the study. Mangroves are dominated by *Avicennia officinalis*, *Bruguiera* sp., *Acanthus ilicifolius* and *Clerodendrum inerme*. Less dominant and scattered species include *Acrostichum aureum* and *Rhizophora apiculata*. Sediment samples were collected at low tide from the exposed intertidal area by using a box corer (120 sq. cm area) up to 15 cm depth. Triplicate samples were made from three tidal zones — low tide, mid tide and high tide levels for two years (1989-91). Samples were pooled and sieved through a 0.5 mm mesh sieve, and the animals remaining in the sieve were collected. Sea anemones were sorted out for further study. Ecological parameters of the study area were also determined. Water characteristics, namely salinity, temperature, pH and dissolved oxygen (Strickland and Parsons 1972) and sediment characteristics, namely sand, silt and clay percentages (Krumbein and Pettijohn 1938) and organic matter concentration (Walkley and Black 1934) were estimated.

Water Characteristics: The water characteristics of the study area are given in Table 1. The most important varying ecological factor was salinity, which varied from 1.2 to 28.7 ppt. The temperature, dissolved oxygen and pH varied from 29.5 to 33.5 °C, 1.6 to 5.4 ml/l and 6.2 to 7.6 respectively.

Sediment characteristics: The sand, silt and clay contents of the substratum are given in Table 2. The entire study area, irrespective of the three tidal levels, was composed of sandy type sediment, with organic matter content varying from 0.6 to 1.53%.

Population density: The population density of *Edwardsia* sp. is given in Table 1. Total density was higher (364/0.1 sq. m) in the high tide zone, followed by mid tide zone (275/0.1 sq. m) and low tide zone (11/0.1 sq. m). The monsoon (June-September) and post-monsoon (October-January) periods showed the highest population density.

The occurrence of the mud dwelling, burrowing sea anemone *Edwardsia* was earlier

TABLE 1

MONTHLY POPULATION DENSITY /0.1 SQ. M OF *EDWARSIA* SP. AND WATER CHARACTERISTICS IN THE STUDY AREA

Year	1989			1990										1991							
Month	Sep	Oct	Nov	Jan	Feb	Mar	May	Jun	Jul	Aug	Sep	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
High tide zone	25	20	8	28	8	36	20	-	34	42	120	8	6	-	-	-	6	3	-	-	-
Mid tide zone	-	14	22	-	6	-	6	-	6	20	25	145	8	6	14	3	-	-	-	-	-
Low tide zone	-	-	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-
Temperature (°C)	ND	ND	ND	31.5	31	29.5	32	31.5	30	30.5	30.5	31	30.5	30.5	32	33	33.5	33.5	31	30	31
Salinity (ppt)	1.5	7.3	15.2	19.1	28.7	21.3	18.8	1.2	1.2	0.6	13.1	17	18.2	24.9	19.9	17.4	19	20.2	1.8	1.9	1.3
Oxygen (ml/l)	2.4	1.8	2.5	3.6	3.9	2.4	2.9	3.2	3.4	2.7	1.6	2.8	3.9	3.5	3.7	1.6	1.9	2.6	4.2	3.2	5.4
pH	ND	ND	ND	ND	ND	7	6.9	7.2	7.2	7.1	7	6.9	6.7	6.2	6.9	7	6.9	7.2	7.5	6.9	7.6

ND = Not determined

TABLE 2
SEDIMENTS CHARACTERISTICS OF THE STUDY AREA
(ALL VALUES ARE IN %)

Tidal Zone	Sand	Silt	Clay	Organic Matter
	March 1990			
High tide zone	87.22	10.38	2.40	1.33
Mid tide zone	88.76	7.62	3.62	0.76
Low tide zone	86.34	5.19	8.47	0.72
	September 1990			
High tide zone	85.86	4.97	9.17	0.78
Mid tide zone	80.92	11.38	7.70	0.95
Low tide zone	85.69	11.56	2.75	0.60
	January 1991			
High tide zone	88.76	3.31	7.93	1.53
Mid tide zone	77.24	2.66	20.10	1.40
Low tide zone	79.67	9.02	11.31	1.10

reported from mangrove soil habitat (Nandi and Choudhury 1983, Athalye and Gokhale 1998) and non-mangrove (Parulekar1968, England 1989) areas within India. None of these studies described the ecological distribution and population structure in detail.

The present study revealed that, in general, the pre-monsoon period (February-May) had the lowest population of sea anemone compared to monsoon and post-monsoon periods. There was striking variation in the population density throughout the study period. The substantial fluctuation in salinity did not affect the population structure of *Edwardsia* sp., which suggests its euryhaline nature.

The sea anemone showed maximum population density in the high tide level area compared to the mid and low tide level areas of the intertidal zone. The low tide zone seems to be unfavourable for the occurrence of sea anemones. This variation in the population density may be related to the tidal inundation process and the nature of the substratum. The high tide zone was exposed all the time, except during high tide, while the low tide zone was almost submerged irrespective of the tidal rhythm. The mid tide zone is exposed to a medium extent. The texture of the sediment was more or less similar, sandy type mixed with mangrove detritus, in all the tidal zones. The slightly more consolidated and water-free substratum of the maximum exposed area of the high tide zone, followed by the mid tide zone, appears to be favourable for the occurrence and burrowing of *Edwardsia* sp. These zones may also provide more suitable ecological niches than the waterlogged sediment of the low tide zone.

The high abundance and occurrence of sea anemone in the high tide zone is due to the adaptations of the species to flooding and desiccation, which enables it to overcome the peculiar environmental changes (i.e the ability to tolerate salinity changes and behavioural and physiological responses, especially respiratory adaptation during the periodic exposure of the area in connection to the tidal cycle) of the intertidal area and thrive there.

Literature survey revealed that the occurrence of *Edwardsia* sp. in Cochin mangroves is a new record for Kerala.

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34. FIRST RECORD OF A CILIOPHORAN *TRICHODINA DOMERGUEI* F. *MAGNA* LOM, 1960 FROM FRESHWATER FISH *PSEUDOAPOCRYPTUS LANCEOLATUS* (BLOCH AND SCHNEIDER) FROM INDIA

(*With one plate and one text-figure*)

Trichodina domerguei f. *acuta* f. n. was found by Lom on the body surface (skin, fins and occasionally gills) of *Cyprinus carpio*, *Perca fluviatialis*, *Lucioperca lucioperca*, *Leucaspis delineatus*, *Rhodeus sericen*. On the skin of tadpoles of several species of frogs, it was identified as *Trichodina domerguei* f. *latispina* Dogel, 1940. The freshwater fish *Pseudoapocryptus lanceolatus* (Family Gobidae) were examined from September, 1999 to January, 2000 for ciliophoran parasites, and the host fish was found to be infested with a European trichodinid *Trichodina domergueri* f. *magna* Lom, 1960.

Trichodinid ciliophorans are known to be dangerous ectoparasites of fishes, causing damage to the gills. In highest degree of infestation, hypersecretion of mucus occurs. In spite of this, erosion of proliferation of the branchial epithelium and occasional haemorrhage occurs. We confirm the existence of an introduced European trichodinid ciliophoran *Trichodina domerguei* f. *magna* Lom, 1960 in India.

Host fishes *Pseudoapocryptus lanceolatus* (Bloch and Schneider) were collected live, brought quickly to the laboratory and gill smears were made on grease-free slides. Smears containing the trichodinid ciliophorans were separated and impregnated with 2% silver nitrate solution. The impregnated slides were exposed to ultraviolet rays for about 25 minutes. Photomicrographs were taken to study morphological variation in the population of the trichodinid. Measurements are given in microns. The terminology and detailed structure of the various parts of the adhesive discs are after Lom (1958), Wellborn (1967), Arthur and Lom (1984), Vanas and Basson (1989, 1992).

Trichodina domergui f. magna Lom, 1960
(collected from India)
(Plate 1, Figs 1-4)

Material examined: (G/23/99) in the collection of the author. Denticle drawings and description based on Vanas and Basson (loc. cit). Blade broad. Apex rounded, parallel with border membrane. Tangent point narrow, pointed at the same level as distal surface. Anterior margin takes a sudden turn to form a notch-shaped structure, occasionally crossing Y-axis (Fig. 1d). Anterior and posterior margins not parallel. Posterior margin of the blade forming deep semilunar depression, slightly above apex. Blade connection thin and short. Central part well developed, angular, fitted tightly with preceding denticle. In most specimens, central part extends almost entirely beyond Y-axis. Ray connection broad. Rays stout, occupying the Y-axis (Fig. 1a-d). Tips of rays blunt, turned towards Y-1 axis (Fig. 1b). Central area with distinct clear portion having argentophilic granules.

TABLE 1
BIOMETRICAL DATA (IN μM) OF *TRICHODINA DOMERGUEI* F. *MAGNA* LOM. 1960

Trichodina species	*Trichodina domerguei* f. *magna* Lom. 1960 collected from India	*Trichodina domerguei* f. *magna* Lom. 1960
Host	*Pseudoapocryptus lanceolatus*	*Nemachilus barbatulus*, *Tinca tinca*
Locality	Midnapore, West Bengal, India	Bohemia
Area of infestation	Gill filaments	Skin
Diameter of body	35.9-42.8 (39.8 ±1.7)	97-98 (82-111)
Adhesive disc	29.6-34.7 (32.7 ±1.6)	70-76 (62-82)
Denticulated ring	19.9-25.5 (21.6 ±1.9)	45-49 (41-55)
Central area	10.7-15.8 (12.7 ± 1.5)	-
No. of denticles	18-22 (22.6 ±1.7)	27 (25-31)
No. of radial pins on denticle	6-7 (6.7 ±0.9)	13-14
Dimensions of denticle		
Length of blade	3.57-4.1 (3.91 ±0.2)	7-8
Width of central part	1.6-2.0 (1.8 ±0.9)	4-4.5
Total length of denticle	4.9-5.8 (4.9 ±0.7)	17
Length of thorn	2.7-4.1 (3.1 ±0.4)	5-7
Width of border membrane	3.1-4.1 (3.6 ±0.4)	5-6.5
Adoral ciliary spiral	375°-390°	-
Incidence	5 of 12 (41.6%)	-

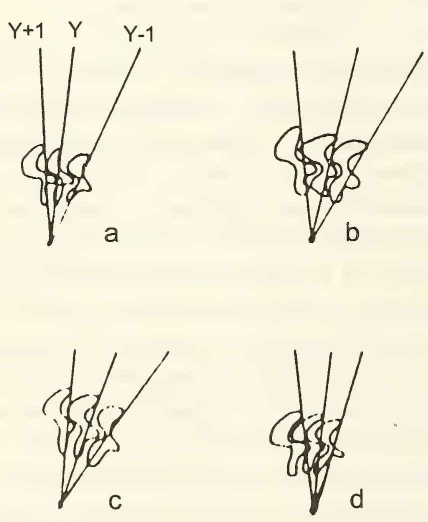

Fig. 2: Comparison of denticles of: (a-b) *Trichodina domerguei* f. *magna* found from (c-d) *Pseudoapocryptus lanceolatus* with the same reported by Lom in 1960

The population of trichodinids studied by us has been identified as *Trichodina domergui* f. *magna* Lom, 1960 after escaning the adhesive disc structure. But the biometrical data does not fall within the reported range of *Trichodina domergui* f. *magna*. (Table 1). The specimens found on *Pseudoapocryptus lanceolatus* were compared with the trichodinids inhabiting freshwater fishes, and it was noted that the blades of both the specimens are curved in the same direction. Anterior and posterior margins of both blades of the specimens are not parallel. The apex in both the specimens almost touches the Y-axis. The posterior margin also forms a deep semilunar curve with Y-axis. The central part is short, triangular in both the specimens. The rays are short with blunt end and directed towards the geometrical centre of adhesive disc. Moreover, no differences in morphology and denticle structure of both the specimens have been noticed. Considering all these factors, we may conclude that the specimen examined is *Trichodina domergui* f. *magna*.

Dash, G.: *Trichodina domerguei* PLATE 1

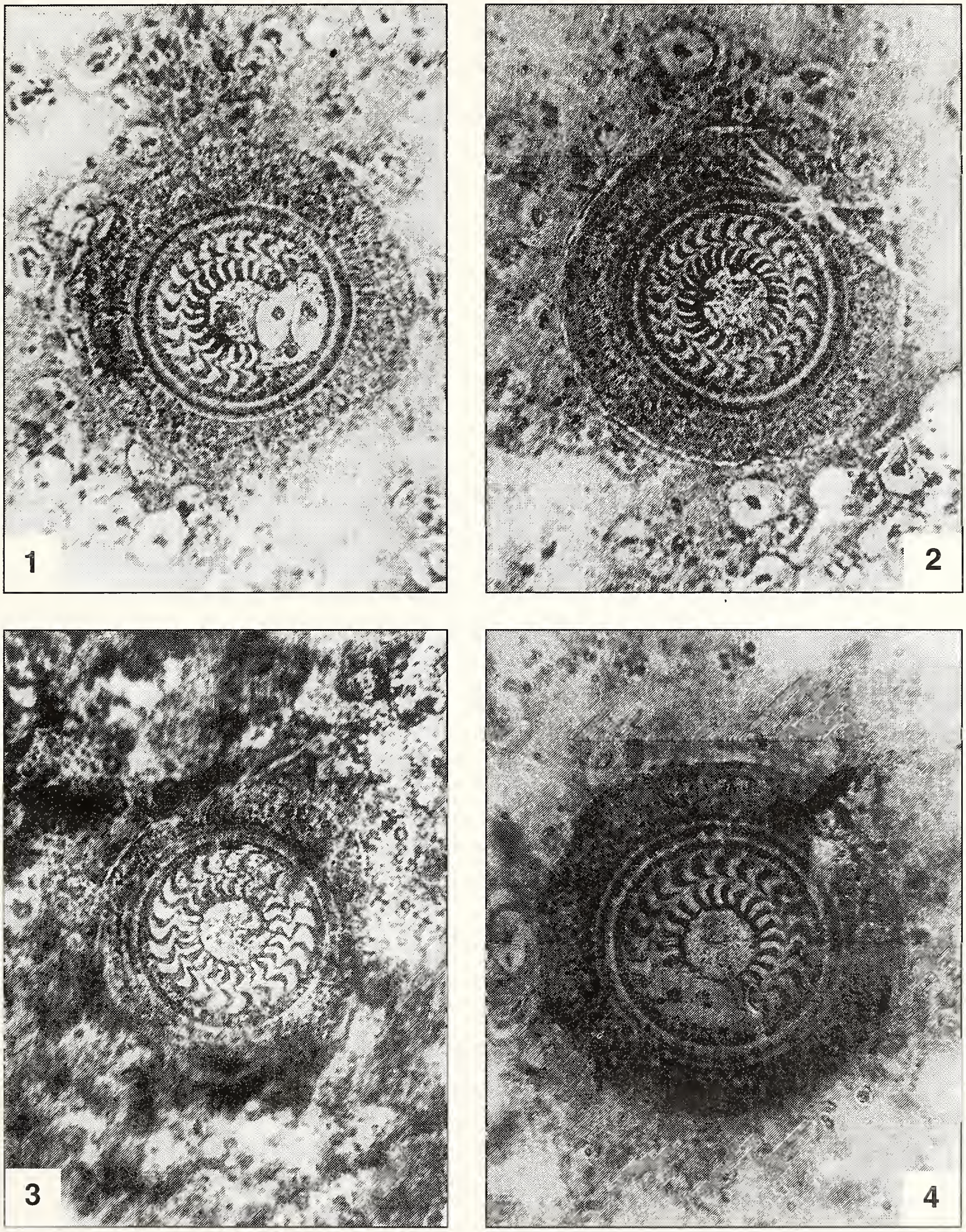

Fig. 1-4: Photomicrographs of *Trichodina domerguei* infecting *Pseudoapocryptus lanceolatus*

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35. A NEW COMBINATION IN THE GENUS *MAYTENUS* MOLINA (FAMILY CELASTRACEAE)

Lourteig & O'Donell (De Natura 1, 1955, 188) correctly transferred the genus *Gymnosporia* Hook. f. to *Maytenus* Molina due to the presence of erect shrubs or trees with spines, cymose flowers and ovary confluent with the disc. While working on the FLORA OF BIHAR, it was found that Haines (Bot. Bihar & Orissa 188. 1921) described a variety under *Gymnosporia rufa* Wall. var. *latifolia* Haines, which is now required to be transferred to the genus *Maytenus* Molina. Therefore, the new combination is given below:

Maytenus rufa (Wall.) Hara var. *latifolia* (Haines) R.P. Bhattacharya, comb. nov.

ACKNOWLEDGEMENTS

I am grateful to the Director, Botanical Survey of India, and Dr. V. Mudgal for their kind help and encouragement.

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36. ON THE NUMBER OF FERTILE STAMENS IN FLOWERS OF *BAUHINIA PURPUREA* L. (LEGUMINOSAE: CAESALPINIOIDEAE)

On the morning of November 11, 1998, I casually plucked a few flowers from two trees of *Bauhinia purpurea* L. cultivated side by side on the banks of the river Hooghly, opposite the Public Relation Officer's quarter in Division 4 of the Indian Botanic Garden, Howrah. They had white petals tinged pink, with a reddish colour on some of the veins, and one of them had, surprisingly, 2 fertile stamens instead of the usual 3. I kept a close watch on the flowers

of the two trees for the next few days and found that they had (2-) 3 fertile stamens. Further, a reduced stamen of varying size was also seen in some of the flowers with both 2 or 3 fertile stamens.

This is a new record for *Bauhinia purpurea*. The voucher specimens collected from the two trees (12.xi.1998, *Bandyopadhyay* 101, 102) have been deposited in CAL.

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37. INTERACTION BETWEEN *ACANTHUS* AND SUNBIRDS AT CORINGA IN ANDHRA PRADESH

Acanthus ilicifolius L., (Acanthaceae) commonly called the spiny, or hollyleaf mangrove, is the best-known species in a closely related group of ground flora mangroves. It is reported to be able to cope with almost all conditions within the mangrove. It occurs typically on littoral margins as a sprawling, vine-like shrub. Usually associated with freshwater influence, it is common in the upper and middle reaches of estuarine rivers and other areas in Coringa, Andhra Pradesh, India.

Acanthus leaves are yellow-green with a margin that is usually, but not always serrate, and prickly. The leaf is glossy, stiff, oblong and lobed, with a short petiole. The flowers are blue with a purple hue. They secrete nectar from a ring at the base of the ovary. The large trilobed lower lip of the corolla forms a landing stage for pollinators. The four stamens surrounding the style have strong filaments, which can only be forced apart by large and powerful biotic vectors. When this occurs, pollen is shed from the anthers onto the vector's body; the receptive stigma also gets powdered with pollen. In effect, self- or cross-pollination takes place. The separated staminal filaments gain their original position when the insect departs. The flowers receive multiple visits because of their original viability and shape. It seems that this floral mechanism is intended for multiple visits so that the legitimate pollinators can effect pollination.

The sunbird species, namely, *Nectarinia asiatica* and *N. zeylonica*, and also large carpenter bees of the genus *Xylocopa* forage for the nectar of *Acanthus* flowers. The birds land on the flowering branch and insert their bill through the staminal column surrounding the style, while the bees use the lower lip of the corolla for landing before probing the flowers like sunbirds. However, sunbirds regularly visit the flowers till they are available. The birds exhibit territoriality by chasing away the intruding bees to exploit the floral source profitably.

Acanthus grows abundantly in the area and serves as a potential nectar source for the sunbirds for 3-4 months from May to August. The interaction between *Acanthus* flowers and sunbirds is symbiotic, and ensures the survivsl of both partners in the mangrove habitats. However, the occurrence of sunbirds is also dependent on plant species that bloom (and provide nectar to birds) outside of the flowering season of *Acanthus*, as appears to be in the case of *Leonotis nepetifolia* (Aluri and Reddi 1994; Aluri 1998).

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38. FLORAL BIOLOGY AND ECONOMIC VALUES OF *HYPTIS SUAVEOLENS* (L.) POIT. IN MEXICO

The genus *Hyptis* with about 400 species (Hickey and King 1988) is a member of the Subfamily Nepetoideae, Tribe Ocimeae, Subtribe Hyptidinae (Cantino *et al.* 1992).* It is Neotropical with only a few weed species extending into the Palaeotropics. Brazil, with over 250 species, is considered the centre of diversity for this genus, with most of them growing as narrow endemics. In Mexico, there are 32 species out of which 22 are endemics (Ramamoorthy and Elliott 1993). *H. suaveolens* has wild and cultivated forms. The wild form is a weedy species and widespread in Mexico, extending its distribution to the Far East of Palaeotropics. The cultivated forms are confined to Mexico. Both forms flower from September to October. The wild flowers are violet with a nectar guide on the upper lip and have anthers and stigma concealed in the carina-like central lobe of the lower lip, set up under tension for explosive release. Foraging bees cause the tense carinal lobe to reflex and explosively release the sex organs, and effect sternotribic pollination (Aluri 1990). The wild form largely differs from the cultivated ones in plant height, stem colour, calyx size, flower colour, manner of carinal lobe releasing the sex organs, seed colour, etc. The cultivated forms are distinguishable into two varieties: i. white flowers with violet nectar guide and ii. white flowers lacking nectar guide. The first form exhibits characters intermediate between the wild and the second form. However, both the cultivated forms release the anthers and stigma passively from the carinal lobe, and contain larger fruiting calyx, requiring an external agent for seed dispersal. The white form with the nectar guide is found in some provinces of Mexico, while the other is completely confined to the State of Colima. There are no reports on the occurrence of cultivated forms of *H. suaveolens* elsewhere.

Close examination of the wild and cultivated forms shows that the cultivated forms might have originated from the wild due to continuous isolation under human care without sexual reproduction with their natural populations. Although there are morphological and functional differences in the three flower forms, they mate well with each other. The foraging bees also do not discriminate between the violet and white flowers and forage alternately between them, transferring pollen from one form to another throughout their flowering season.

H. suaveolens is locally known as 'Chia' or 'Chan'. Its seeds are used in sauces, and as a thickening agent in the preparation of cookies and biscuits. A traditional drink is also prepared with the seed flour mixed with ice water and honey. It is good for digestion and has a cooling effect on the stomach. 'Chan' ice is also sold in the market. The seeds yield 18-23% protein and 13-23% oil content, indicating their high nutritive value. The oil is used in cooking and is an excellent preservative for colours. The leaves are used as an appetisers, to combat indigestion, stomach pain, nausea, flatulence and cold, for wound healing and skin infections. The leaves also yield an essential oil, which inhibits the growth of fungi such as *Candida albicans* and *Helminthosporium oryzae,* and bacteria such as potato pathogenic bacteria (Pandey *et al.* 1981,

1982; Singh *et al.* 1983; Tiwari *et al.* 1987; Fun and Svendsen 1990; Rojas *et al.* 1992).

Preliminary research on food and medicinal value of *H. suaveolens* shows that the weed can be best exploited as a new potent food crop by developing countries, which have food grain crises, and as a potent antifungal and antibacterial agent. The results of our field studies are encouraging to include *H. suaveolens* in the list of new crops. The cultivated forms are particularly suitable as they have a larger fruiting calyx in which the seeds are retained for a longer time, facilitating harvest. Further, the wild and cultivated forms during their flowering phase sustain a variety of bees, especially the honeybee *Apis mellifera*, which voraciously gathers pollen and nectar exhibiting fidelity. Therefore, the potential of *H. suaveolens* for agricultural use seems great, as it is a low-water user and can grow on moist to dry soils.

The research was supported by the funds from Consejo Nacional De Ciencia y Technologia of Mexican Government through CGDIC of the University of Colima, Colima, Mexico. The study was conducted at Colima during September-October 1996.

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39. *THOTTEA DINGHOUI* SWARUP, FAMILY ARISTOLOCHIACEAE, A NEW RECORD FOR TAMIL NADU

(*With one text-figure*)

While botanizing in the Kalakad-Mundanthurai Tiger Reserve (KMTR) in Agastyamalai hills, Tamil Nadu, an interesting specimen, which showed close affinity to *Thottea barberi* (Gamble) Ding Hou. was collected. On comparing the specimen with the descriptions

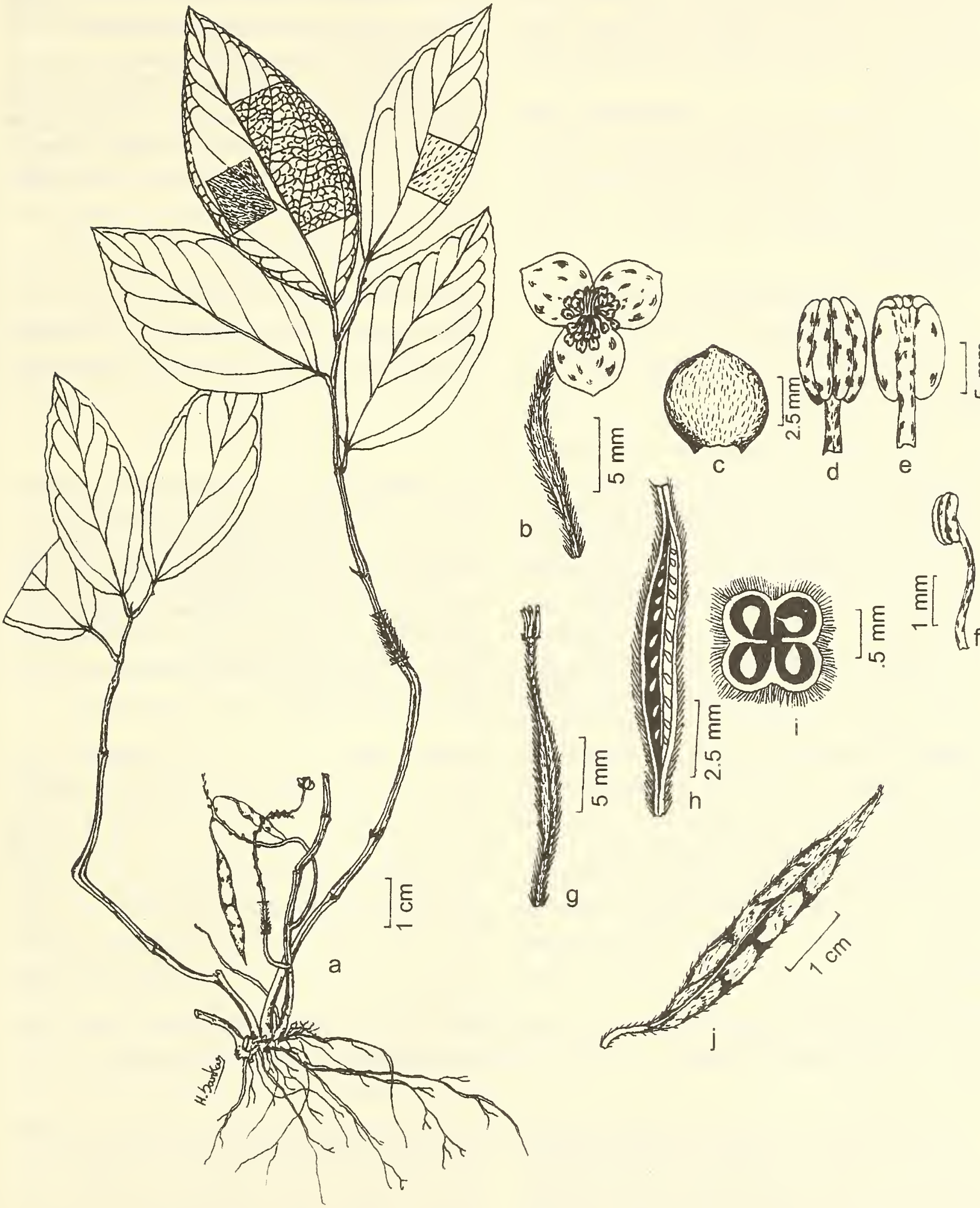

Fig.1: *Thottea dinghoui* Swarup, a. Habit; b. Flower; c. Sepal; d-f. Stamen (adaxial, abaxial and lateral views); g. Pistil; h-i. Ovary (longitudinal and transverse sections); j. Capsule.

in literature and specimens in MH, it was identified as *Thottea dinghoui* Swarup, a new species from Kerala, hitherto unrecorded from Tamil Nadu.

The description and illustration of the species are given, along with distribution, ecology and phenology. The voucher specimens are deposited in the St. Xavier's College Herbarium (XCH), St. Xavier's College, Palayamkottai.

Thottea dinghoui Swarup
In: Blumea 28 (1983): 407-411

Erect herbs, 30-50 cm tall; stem rusty, pubescent. Leaves alternate, elliptic-oblanceolate, margin entire, apex acute, base acute to slightly obtuse, densely villous below, less so above, nerves prominent, *c.* 5 pairs, 9-17 x 3-8 cm; petiole up to 1 cm long. Inflorescence radical, *c.* 8 cm long; peduncle up to 0.5 cm long. Flowers 7-10, alternate, pale yellow; bracts and bracteoles small. Calyx 3-lobed, free, ovate-elliptic-orbicular, apex acute, base cuneate, hairy without, glabrous within, up to 5 mm long. Corolla 0. Stamens many, 15-20, in two whorls; filament short, connate at base, anther 2-celled, glabrous. Ovary oblong, *c.* 1 cm long, hairy; ovules numerous, in axile placentation; style short. Stigma 3-6 lobed. Capsule hairy, up to 5 cm long, quadrangular, pale pink. Seeds many.

Distribution: Prior to the present finding, reported only from Idukki district, Kerala. Probably endemic to southern Western Ghats, India.

Remarks: Extremely rare species, growing in the evergreen forests as undergrowth.

Fl. & Fr.: August-December.

Material examined: Tamil Nadu: Tirunelveli district, Sivasailam, V.S. Manickam 16673, 17174 (XCH). Kerala: Idukki district: C.N. Mohanan, Kulamavu 74117, 81603 (MH), A.G. Pandurangan, Meenmutty-Kulamavu 76679 (MH), Mount Calvary 79233 (MH).

Note: *Thottea dinghoui* Swarup is closely allied to *Thottea barberi* (Gamble) Ding Hou and *Thottea siliquosa* (Lamk.) Ding Hou, but differs in the habit, inflorescence and leaf morphology.

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40. OCCURRENCE OF *NERVILIA ARAGOANA* GAUD. (ORCHIDACEAE) ON THE NALLAMALAI HILLS, EASTERN GHATS IN ANDHRA PRADESH

During a survey of medicinal plants of the Nallamalai Hills, Eastern Ghats, Andhra Pradesh, we collected specimens of an interesting ground orchid that was examined and identified as *Nervilia aragoana* Gaud. A survey of the literature revealed its presence in the hilly tracts of Western Ghats, Himalayas and Eastern Ghats. It has been reported to occur in Rampa Hills, Eastern Ghats, Andhra Pradesh (Gamble 1967). However, there exists no report of its occurrence from the Nallamalai Hills (Ellis 1968, 1987; Krishna Mohan 1985; Raju and Pullaiah 1995).

Hence, this is a new distributional record from Eastern Ghats of Andhra Pradesh. The voucher specimens have been deposited in R.R.C. (Ay.) Herbarium, Vijayawada (F. No. 3772, 12.xi.1998, near Pedda Manthanalamma area, Kurnool District, Andhra Pradesh, coll. P. Dwarkan, Srinivasulu, Vasudeva Rao, Nagulu).

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41. ABNORMAL BRANCHING BEHAVIOUR OF WILD DATE PALM *PHOENIX SYLVESTRIS* ROXB. (PALMAE)

During a survey of the forest areas of Deola Forest Range in Udaipur district, I came across a wild date palm (*Phoenix sylvestris* Roxb.) with abnormal branching. The tree was growing in an agricultural field, nearly 2 km away from Akyawar Forest Nursery, towards the western side on Udaipur-Sirohi Road. This young tree had 125 shoots of different sizes in the basal region. Nearly each leaf of the basal region had produced a shoot. These shoots looked like a circular fence around the main trunk. Basal leaves of all the surrounding shoots had also produced several shoots. I am observing this tree since 1993, and it is still producing new shoots.

It is, perhaps, the wild date palm having the largest number of shoots in Rajasthan, and is hence worth placing on record.

June 14, 1999

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42. AN EFFECTIVE ETHNOBOTANICAL MEDICINE AGAINST HEMIPLAGIA

This article deals with the ethnobotanical use of three medicinally important plants used by the local *vaidya* of Khatana village against the dreaded disease hemiplagia, i.e. paralysis. Khatana village lies in Dharampur taluka, Valsad district, south Gujarat, on the northwest side of the Western Ghats (20° 5' N; 73° 7' E). It is about 8 km away from Dharampur on its east.

The plants used are as under:

(1) *Moringa concanensis* Lam.

Local name: Kadvo Saragvo

Family: Moringaceae

It is a tall tree with a rough, greyish-brown trunk.

Used part: Splintered bark of stem.

(2) *Blumea eriantha* DC.

Local name: Kapur

Family: Asteraceae

It is a strong aromatic herb, flower heads with yellow florets in axillary and/or terminal, paniculate cyme.

Used part: Extract of fresh flowers.

(3) *Mentha piperita* Linn.

Local name: Peppermint

Family: Lamiaceae

It is an aromatic perennial herb.

Used part: Extract of fresh flowers.

Treatment: The oil is extracted from the fresh flowers of *Blumea eriantha* and *Mentha piperita*, and mixed in almost equal proportions. It is then massaged for about half an hour on the paralysed part. Later, the splintered bark of *Moringa concanensis* is tied tightly on to the massaged part for about an hour. This treatment is very effective in giving relief from pain, enabling the patient to move the paralysed part freely. Many patients from Pune, Mumbai, Nasik (Maharashtra), Vadodara, Ahmedabad (Gujarat), and other parts of nearby states visit this place for Hemiplagia treatment.

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4. Photographs for reproduction must be clear, with good contrast. Prints should be at least 9 x 12 cm and on glossy glazed paper. Text-figures, line drawings and maps should be in Indian ink, preferably on tracing paper.

5. References to literature should be placed at the end of the paper, alphabetically arranged under author's name, with the abridged titles of journals or periodicals in italics and titles of books or papers in roman type, thus:

   Aluri, Raju J.S. & C. Subha Reddi (1995): Ecology of the pollination in two cat-mint species. *J. Bombay nat. Hist. Soc. 92(1)*: 63-66.

   Prater, S.H. (1948): The Book of Indian Animals. Bombay Natural History Society, Mumbai. pp. 35-48.

6. Each paper should be accompanied by an abstract, normally not exceeding 200 words, and 6-8 key words. Key words should include the scientific names of important species discussed.

7. 25 reprints will be supplied free of cost to authors of main articles and new descriptions. Authors of miscellaneous notes, will be sent a free copy of the Journal.

8. The editors reserve the right, other things being equal, to publish a member's contribution earlier than a non-member's.

9. For the standardised common and scientific names of the birds of the Indian subcontinent refer to *Buceros* Vol. 6, No. 1 (2001).

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Destroying by protection

WE ALL KNOW that habitat destruction and mismanagement, poaching, illegal trade, and corruption are playing havoc with Indian wildlife, but not many may know that misguided sentiments are also destroying many wildlife species. For instance, millions of birds are caught every year for religious people to release on auspicious occasions! Many species are dying as a consequence of over-protection of other species. The great Indian bustard is one of the unfortunate examples.

Besides suffering from poaching and massive habitat destruction, the great Indian bustard now faces another challenge – increasing numbers of blackbuck and a backlash from the local people. Wherever measures have been taken to protect the bustard and its habitat, the greatest benefit has gone to blackbuck. In Karera Bustard Sanctuary, the blackbuck increased from 50-60 in 1982 to nearly 700-800 in 1992; in Nannaj Bustard area near Solapur, they increased from 100-120 in 1982 to nearly 700 in 1997; in Rollapadu Wildlife Sanctuary they increased from 17 in 1985 to 400-500 in 2000. Besides, the blackbuck has increased in many areas in Gujarat, Rajasthan, Madhya Pradesh and Maharashtra, thanks to the Wildlife (Protection) Act, 1972, and peoples' cooperation. But farmers are not happy, and rightly so. Unlike the bustards, the blackbuck is not harmless to humans. It relishes what the farmers grow, but the farmers obviously do not relish this. The result is a backlash against the conservation movement. We have seen villagers turning from active support of bustard conservation to fierce opposition to any conservation action. Which poor farmer would tolerate destruction of his crops season after season? The consequences are clear. No bustard is left in Karera Bustard Sanctuary; three bustards poisoned in Sorsan Bustard Area in Baran in Rajasthan; 15-20 left in Rollapadu, compared to 60-100 fifteen years ago; no bustard seen for the last three years in Rannibennur Blackbuck Sanctuary (10-12 in mid 1980s). Now you cannot talk of bustard conservation in many rural areas in Madhya Pradesh, Gujarat and Maharashtra. Are the people against the bustard and conservation in general? Surprisingly, no. They do want to protect bustards – at one time Karera became important because of this species. Rollapadu came into the limelight, and tourists visit Nannaj to see the bustard. But farmers do not want their crops destroyed by the bustard's companion species, the blackbuck. Fair enough. Would city-based animal rights activists allow their potted plants or costly bonsais to be destroyed by stray cows? And remember, the activists' survival does not depend on ornamental plants and kitchen gardens, while the poor farmer's yearly earning could be eaten away overnight by a herd of blackbuck.

What is the solution? Translocation — the farmers suggest; culling — the rational scientists and wildlife managers recommend; introduction of a predator of blackbuck, change in cropping pattern, crop compensation - the animal rights activists suggest. Perhaps all these measures apply at different levels in different areas, but the end solution is controlling the number of blackbuck. Translocation of medium-sized antelopes is not impossible (South Africans are expert in catching and translocation of ungulates so we can learn from them) but are we not 'translocating' the problem instead of solving it? The idea of introduction of a predator (wolf) seems exciting and media-friendly to novice wildlifers, but wolves are already present in most of the blackbuck-problem areas. In case they are not present, where will we bring them from? The wolf itself is rare. Another, more pertinent, question is: will

increase in wolf population control the number of blackbuck? Armchair animal lovers, 'educated' by the sight of a cheetah chasing an impala or a pack of lions bringing down a wildebeest in the Serengeti plains, think that predators control the population of prey, but this is not true in most cases. Ecology tells us that it is the other way round – the population of prey determines how many predators an area can support. The Rollapadu grassland has a pack of 9 wolves, while Nannaj has a pack of 10-12 animals. They have not been able to control the galloping blackbuck numbers. Our studies indicate that each pack requires at least 20 sq. km of good habitat with a large prey base (wild and domestic). Like any predator, the wolf is highly territorial, so the resident pack will chase out introduced wolves. Moreover, shepherds would not like the introduction of wolves, as they would not want to lose more valuable sheep or goats. Therefore, translocation of wolf to control blackbuck numbers is out of the question.

Another suggestion is to change the cropping pattern. This is not easy. Market forces, personal requirements, rainfall, soil and water conditions determine the crop pattern – not the blackbuck! Moreover, it is not only feeding on the crop but also thrashing by territorial bucks that does considerable damage to standing crop. Crop compensation appears to be a solution to some people. First of all, it is not easy to quantify the crop damage. Even if we are able to do so, who will pay the compensation? The state forest departments are already starved of funds. Nearly 40% of the posts are vacant due to paucity of funds. Should we divert scarce resources to pay compensation running to millions of rupees? Secondly, for how long and how big an area should compensation be given? Thirdly, it would lead to massive corruption, with rich influential farmers cornering the compensation in connivance with forest guards, leaving poor, disgruntled farmers nursing more resentment against the conservation movement. Lastly, is crop compensation a long-term solution?

What do other countries do when faced with a similar situation? The United Kingdom has an intensively managed countryside with a long history of predator control. Fortunately, predator control to increase the population of common 'game' species for pleasure shooting has been outlawed or severely curtailed, but such control does take place even now, when the survival of a rare species is involved. The red deer is a problem animal in many nature reserves of the Royal Society for the Protection of Birds (RSPB). The RSPB recommends regular culling of red deer at many of its reserves. For instance, the population of capercaillie, a large handsome grouse inhabiting old forest with thick underbrush, is fine-tuned to its natural habitat. Increasing numbers of red deer destroy the underbrush, resulting in the decline of capercaillie. Putting up a deer fence was found not to be the solution. The fence is not easily visible to these highly excitable terrestrial birds, and when disturbed they fly directly into it. More than 16% of collisions of capercaillie, black grouse and red grouse are fatal. As predators often remove the casualties quickly, the true fatality figure is probably much higher. The only long-term solution is to reduce the number of red deer by culling. This recommendation has come from a bird conservation organization with more than a million members. In the United States, control of deer numbers is a regular management practice. In none of the countries has controlled culling resulted in the extinction of any ungulate. Only in our country, any talk of culling problem animals sends animal rights activists into paroxysms. Interestingly, culling of blackbuck to reduce crop damage was practiced earlier in our country. The Raja of Wankaner, a former estate in Gujarat, had fixed a quota of blackbuck that had to be culled to prevent excess damage to crops in his region.

Based on its scientific research, the Bombay Natural History Society feels that the time has come to control the locally abundant populations of certain species such as nilgai, wild boar and blackbuck. The forest department should take up controlled culling under strict supervision. At the same time, we should also develop the technique of capture and translocation, natural birth control and crop aversion technology. Our detailed scientific studies in Rollapadu Wildlife Sanctuary have shown that blackbuck numbers should be kept at less than 100 in this Sanctuary. If we neglect the crop damage problem further, we will not only lose species such the great Indian bustard but also the support of a very large rural constituency. The ultimate sufferer will be the conservation movement in India.

ASAD R. RAHMANI

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INDIAN WILD ASS (*EQUUS HEMIONUS KHUR*) IN THE LITTLE RANN OF KUTCH, GUJARAT, INDIA[1]

H.S. Singh[2]

(*With two text-figures*)

Key words: Indian wild ass, Little Rann of Kutch, Gujarat

The Little Rann of Kutch is a unique saline desert and is synonymous with the Indian wild ass, locally called ghor khar. The numbers of this only population of *Equus hemionus khur* Lesson in the world, declined consistently as a result of disease and habitat loss before the declaration of the area as a Sanctuary. Though original habitat continued to be lost due to invasion of *Prosopis chilensis,* grazing, salt-works and encroachment, the wild ass population increased consistently after 1976. As per various estimates and censuses in the past, the population decreased from 3,000-4,000 in 1946, to a few hundreds in 1963. But a reverse trend set in after 1976, when the number increased from about 720 in 1976 to about 2,940 in 1998. The rate of population growth of this species was about 4.8% per year during the last decade and wild asses started dispersing to new areas away from the Sanctuary in the Great Rann of Kutch and Bhal regions. Wild asses were also seen in the Kala Dungar area of the Great Rann, Bhal region and in areas of Rajasthan bordering Gujarat. This paper deals with the population trend, distribution, migration and population characteristics of the wild ass. Encounters in different habitat types revealed that though the barren Rann does not provide food and water, it is an important habitat for the wild ass. Attempts were also made to study the habitat utilisation pattern and management problems of the Sanctuary for conservation of the wild ass in the region.

Introduction

There are three species of wild ass in the world, one in Africa and two in Asia. The African species has two subspecies, whereas the two Asian species are classified into eight surviving subspecies: *Equus hemionus hemionus*, *E. h. luteus*, *E. h. kulan*, *E. h. khur*, *E. h. onager*, *E. kiang kiang*, *E. k. holclereri* and *E. k. polyodon* (Shah 1993, Ryder and Chemnick 1990). The Indian wild ass (*E. h. khur* Lesson 1827) is one of the five surviving subspecies of *E. hemionus* and is endemic to the Rann of Kutch. During the 20th Century, the Indian wild ass had a fairly wide distribution in the dry regions of northwest India and west Pakistan. The wild ass of Sind (*E. h. khur*) was hunted by the great Moghul Emperor Akbar, on the banks of the Sutlej river in 1571 (Rao 1957). The wild ass population declined gradually over the centuries, but there was a drastic reduction between 1960 and 1969, due to an outbreak of the South African Horse Sickness and the arthropod-borne *Surra* disease (Gee 1963). The species is now in the Red Data Book as per the IUCN Threat Criteria.

[1]Accepted February, 2001

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Study Area

The Little Rann of Kutch, Gujarat State, is an unique saline desert, synonymous with the Indian wild ass, the only gene pool of *E.h. khur* in the world. To conserve this animal, an area of 4,954 sq. km in the Little Rann, its fringe areas and some *beyts* (islands) in the Great Rann of Kutch were declared as the Wild Ass Sanctuary in 1973. Kutch, Banaskantha, Mehsana, Surendranagar and Rajkot districts, and Gulf of Kutch constitute the boundaries of the Sanctuary. Recognising its uniqueness and ecological significance, the area has been listed by the Government of India, among the first 13 areas identified for conservation as Biosphere Reserves, which is pending with the Gujarat State Government for a final declaration as the Little Rann Biosphere Reserve.

The Rann is characterized by a dry tropical climate with a brief erratic monsoon, hot summer and cold winter. The silt-laden inundation from rivers like the Banas, Saraswati, Rupen, and several small seasonal streams, along with high tides from the Gulf of Kutch through Surajbari creek, have contributed significantly towards the formation of this saline flat. The Little Rann gets flooded under 0.5 m to 1.0 m water every monsoon. Though a major part of the Rann changes into dry mudflats after November, numerous water bodies support a large number of resident and migratory birds in winter.

The Sanctuary is classified into: (i) the Rann (3,464 sq. km), (ii) *beyts* (185 sq. km), and (iii) fringe areas (1,304 sq. km). Seventy-four elevated plateaus or islands (locally called *beyt*) were identified through remote sensing, of which 51 *beyts* were vegetated, whereas the rest were barren. The area of the *beyts* varies from 4.7 ha — *beyt* Panchham to 3,050 ha — *beyt* Pung. Six *beyts* have an area of over 1,000 ha. Nanda is the only *beyt* with human habitation and cultivation. About 33% of the *beyt* area is under *Prosopis chilensis*, while herbaceous vegetation constitutes 23% of the net area.

Methods

The GEER Foundation conducted a comprehensive ecological study in the Wild Ass Sanctuary from November, 1997 to February, 1999. The author coordinated the study and the paper is primarily an analysis of the field data collected by the scientists and research assistants during this study. The Rann, fringe area, *beyts* of the Sanctuary and Khadir *beyt* were surveyed. Remote sensing study was carried out to know the vegetation cover and habitat conditions.

The Sanctuary area was divided into three regions and seven zones - south fringe, eastern fringe, northern fringe, western fringe, creeks, *beyts* and part of the Sanctuary in the Great Rann. Vehicular and foot transects were done to collect evidence of the occurrence of wild ass. Dung was recorded in all the transects. Locals were questioned to collect more information.

An 18 day count of the wild ass in and around the Little Rann was done in November, 1998. The Great Rann and other habitats were also surveyed to estimate the dispersed population. Data from the wild ass census by the Gujarat Forest Department on January 28 - 29, 1999 was also used. To count wild ass, the Sanctuary and its fringe areas were divided into three regions- (i) *Halwad–Dhrangadhra region*: fringe zones in Surendranagar and Mehsana district, the Rann and *beyts* near the boundaries of two districts; (ii) *Radhanpur region*: fringe zone in Banaskantha, the Rann and *bets* of the Little Rann and Great Rann of Kutch near the boundary of Banaskantha district; and (iii) *Bhachau region*: both sides of Surajbari-creek, fringe area of Rajkot and Kutch districts, the Rann and *beyts* near Kutch and Rajkot districts.

Wild asses were counted on some of the important *beyts* in the rainy season in 1998 to study the breeding area. Pung, Dhut, Nanda, Shedwa, Mardak, Fatehgadh, Nada, Khadir and other *beyts* in the Great Rann were surveyed extensively in November-December, 1998.

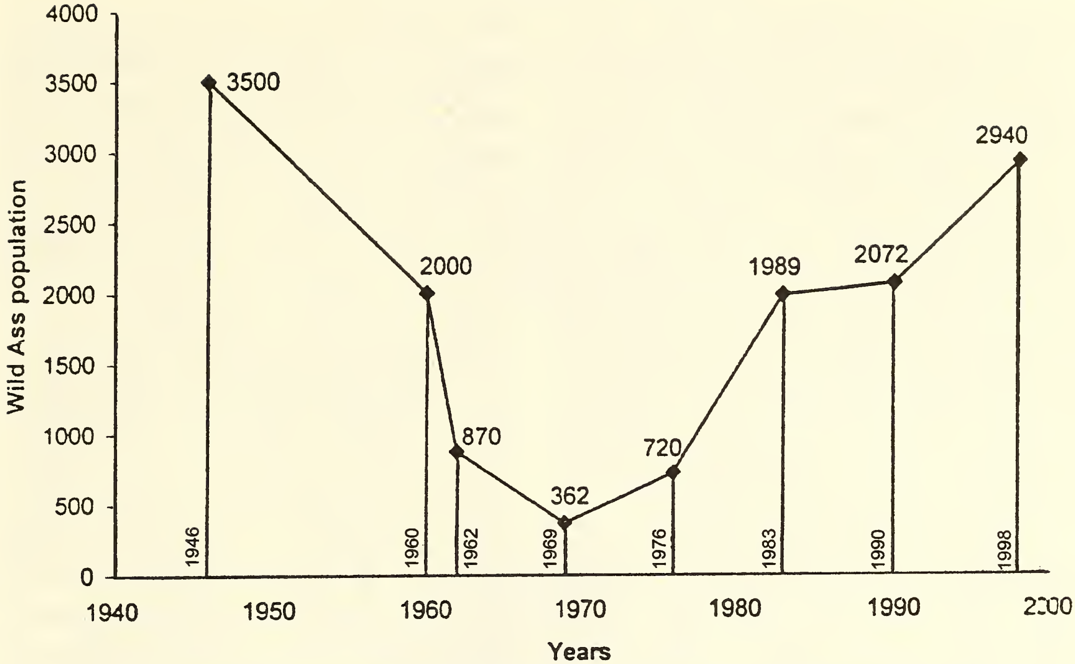

Fig.1: Trend in wild ass population during the last 50 years in the Little Rann of Kutch

Observations were made up to the border of Rajasthan and Pakistan.

Results and Discussion

Population Trend: Ali (1946) estimated the wild ass population between 3,000 and 4,000 in the Little Rann. In 1960, he estimated a population of about 2000 *khurs*. In 1958 and 1960, the arthropod borne *Surra* disease caused by *Trypanosoma evansi* had taken its toll (Gee 1963). In November-December, 1961, some wild asses died in an outbreak of South African Horse Sickness, reducing the population to 870 individuals in 1962 (Gee 1963). The Gujarat Forest Department recorded 362 wild ass in 1969 in an aerial survey. Since then, the Gujarat Forest Department has conducted four censuses and found that the population increased consistently from 720 in April 1976, to 1,989 in April 1983, 2,072 in March 1990, and 2,839 in January 1999. The comparatively low increase from 1983 to 1990 was probably due to a severe drought from 1985 to 1987.

The GEER Foundation conducted systematic counting of wild ass in and around the Little Rann in November 1998, up to 5-10 km from the Sanctuary boundary. A total of 2,446 animals were counted, not including the wild ass inhabiting the Great Rann and the outer zone beyond 10 km from the boundary. Partial counting was done in and around Khadir, Tragdi, Fatehgadh, Nada and other *beyts* in the Great Rann. Two groups were also counted near Nalsarovar and Dhandhuka-Dholera Highway in Ahmedabad district. On the basis of partial counting, reports of forest officials and locals, it was estimated that over 490 wild asses were dispersed in the Great Rann and in outer areas beyond 10 km south from the boundary of the Sanctuary, up to Dhandhuka (Bhal region). Thus, the total population estimated by the Foundation in November, 1998 was 2,940. The Little Rann and its surrounding zones had not

experienced severe drought as in 1987. This is one of the main reasons for the consistent rise in population at 4.8% per year (1990-1998). The Gujarat Forest Department census in January, 1999 estimated the population at around 2,900.

Population Distribution: The study estimated a total of 1,780 wild ass in Dhrangadhra-Halwad region, 590 in Bhachau and 570 in Radhanpur. It was noted that 390 to 490 wild asses stayed beyond 10 km from the boundary of the Sanctuary. Also, about 70% of the total population is found in Dhrangadhra/ Halvad zone (eastern and southern fringes along with Rann, *beyts* and other areas near these fringes). Distribution pattern also revealed that the dispersed population was on the rise.

Distribution of wild ass population varied from season to season as wild asses congregated in the fringe areas and on the *beyts* during monsoon. Although their movement was restricted during monsoon, they were observed moving from *beyt* to *beyt* and from fringe to *beyt* wading in shallow water. Three hundred and fifty-eight wild asses congregated on Pung *beyt* and its neighbouring *beyts* during monsoon in October 1997. This is because groups from fringe areas moved to the *beyts* during the breeding season. Ali (1946) also mentioned congregation of about 200 wild ass on Pung *beyt*. The area-wise distribution of wild ass is given in Table 1.

Dispersal/Migration: In 1976, the wild ass was restricted to a 5 km belt from the Sanctuary fringe (Shah 1993). Animals migrated to areas beyond 10 km from the southern Rann fringe in 1989. South-eastern fringes are rich in food and water resources — maximum concentration of population and dispersal was observed in the peripheral villages in these fringes. People believe that wild asses started moving away from the Sanctuary after the 1987 drought. During our survey, 38 individuals were seen on Khadir, Bangara and Kakidiya *bets* northwest of Khadir, and over 60 wild asses were estimated on and around Khadir *beyt*. The local people confirmed that wild ass was not seen in this area 15-20 years ago, but is consistently seen in increasing numbers now. During the same period (November-December, 1998), 53 wild asses were encountered in part of the Sanctuary in the Great Rann (26 in Fatehgadh, and 27 in Nada and other *beyts* near Rajasthan). Eighteen wild asses were also seen in March, 1999 on Tragadi *beyt* which is located about 15 km west of Dholavira (Khadir). Dr. Ketan Tatu (*pers. comm.*) observed a herd of twelve wild asses in Kala Dungar area in the western part of the Great Rann in February, 2000; and the villagers have seen this group for the last 3-4 years. He photographed these animals as part of evidence for a study of GEER Foundation in the Great Rann. Three wild asses (two adults and one foal) were seen at the Rajasthan border area. Border Security Force (BSF) personnel claimed to have seen a group of 9 individuals in Rajasthan. A track from Bela to Tuta towards the Pakistan border indicated that animals visited the border, which was confirmed by the BSF personnel.

Some wild asses had migrated out of the Sanctuary to Nalsarovar Bird Sanctuary and Bhal area. Sightings were also made near Dhandhuka-Dholera highway. A group of 18 wild asses was recorded near Kalatalav in the monsoon of 1998, south of Nalsarovar and another group of

TABLE 1
AREA-WISE POPULATION DISTRIBUTION IN NOVEMBER, 1998

Area	Population	Percentage (%)
Rann	688	23.4
Beyts in the Rann	541	18.4
Fringe areas (vegetated zone in fringe up to 10 km from boundary)	1,271	43.2
Dispersed population beyond 10 km from boundary of Sanctuary (estimate)	440	15.0
Total	2,940	100.0

Note: Wild ass population on *beyts* was 488 individuals in the Little Rann and 53 individuals in the Great Rann.

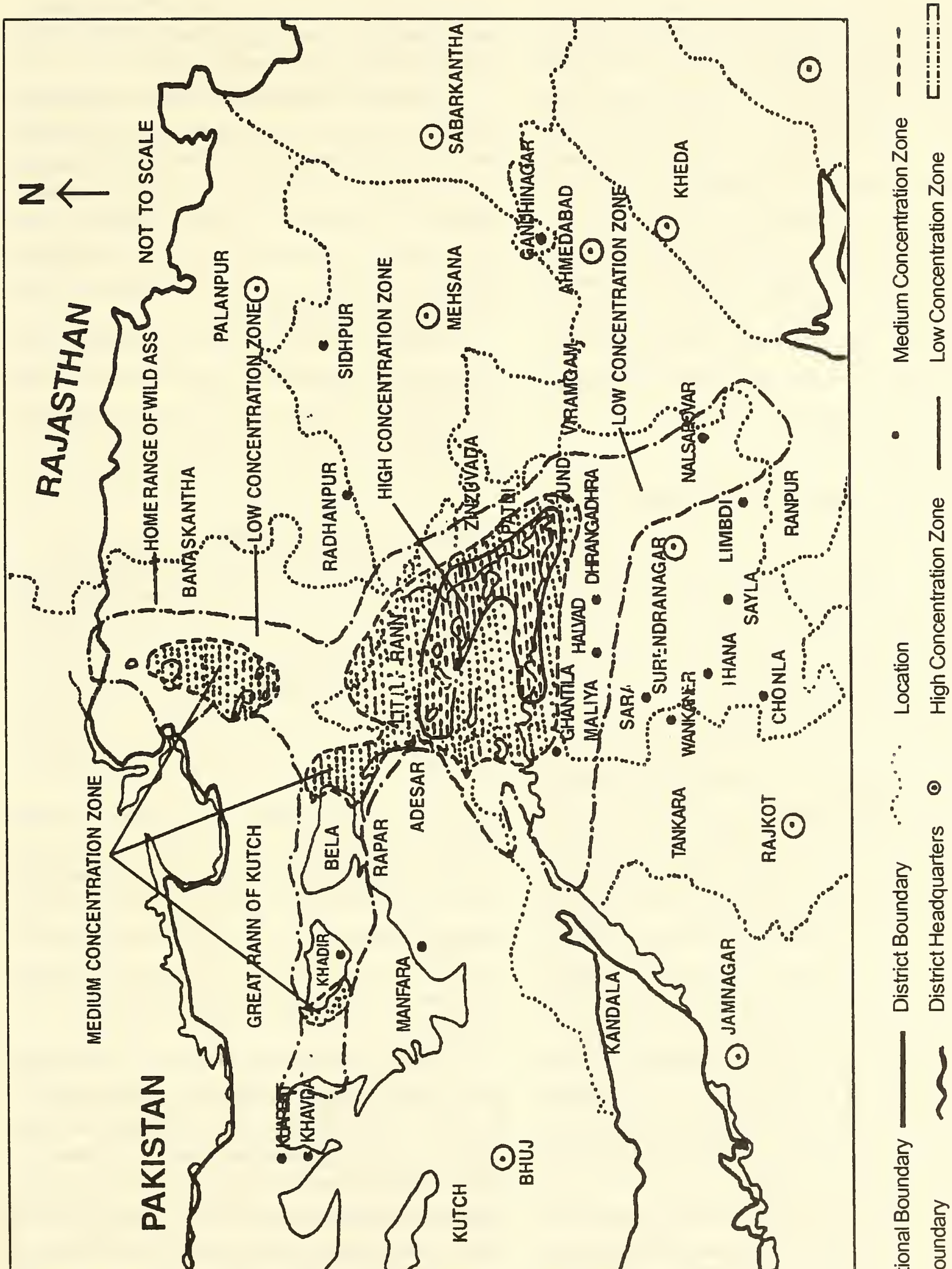

Fig. 2: Distribution of the Indian wild ass

6 animals was seen near Devadthal during the same period. It was also seen near the Limbdi-Vadodara highway. The wild ass census and this survey established the fact that wild ass had dispersed northwards to the Rajasthan and Pakistan border, Dhandhuka-Dholera highway and to the south of Limbdi-Bagodara national highway in the south and Malia in the west.

Population Characteristics: Mating and foaling in the Little Rann occur during monsoon (July–October), which is also a period of vegetation growth. All births are single. Male foals are weaned at 1-2 years of age, while female foals continue to remain with mares for longer periods (Shah 1993).

Of 2,446 wild asses counted in and around the Little Rann, there were 637 males, 1,402 females and 407 foals. It is possible that some of the subadult males could not be distinguished from females and hence the male population was underestimated. But this observation confirms the finding of Shah (1993) that the male:female ratio was 1:2 in the Sanctuary.

Drought certainly affects reproduction. The area did not face severe drought after 1987, therefore the population consistently increased from 2,072 in 1990 to 2,940 in 1998. Out of 407 foals counted in November 1998, 267 were born in the monsoon of 1998. Thus, foals constituted 16.6% of the total population of wild ass (young foals 10.5%). It is difficult to distinguish a one-year foal from a subadult. Thus, some young of the previous year could not be included in the list of the foals. In addition to the 267 foals in and around the Sanctuary in 1998, about a dozen foals were seen in the outer zones in the Great Rann, Rajasthan and Bhal region in the same year. Thus, it may be concluded that more than 275 foals were born in 1998.

Large herds of wild ass were recorded at Visnagar 89, Koparni 86, between Kanach and Thala Rann 70, Kidi 68 and Degam Rann 61. Nearly 60% of the total were recorded in small to medium groups of 3-20 or 21-40, and 36% in large groups (41 to 90). About 1.8% wild asses, mainly males, were single, whereas 1.5% of the total population were seen in pairs.

Habitat Utilisation: Habitat utilisation pattern of wild ass in and around the Sanctuary zone was studied separately. The pattern changed when peripheral villages were included with the Sanctuary for analysis. Daytime distribution of wild asses in and around the Little Rann in November, 1998 up to about 10 km from the boundary is given in Table 2.

Analysis of the data showed that over 40.0% of all the animals sighted were recorded in the barren Rann, which does not support vegetation. The percentage came down to 29.3% when the population in the fringe areas outside the Sanctuary was also counted with that of the Little Rann. This proves beyond doubt that, although a large area of the Rann does not provide food, it does provide space for resting and movement. Vegetation types, grass *Suaeda* types and *Suaeda* with sparse *Prosopis* cover were other preferred habitats of the animal.

TABLE 2
HABITAT-WISE DISTRIBUTION OF WILD ASS IN THE SANCTUARY IN NOVEMBER, 1998

Habitat type	No. of wild asses	Percentage
Rann	716	29.3
Grass/*Suaeda*/herbaceous cover	660	27.0
Sparse *Prosopis* cover in grassland	690	28.2
Moderate to dense *Prosopis* cover	229	09.3
Cultivated fields	151	06.2
Total	2,446	100.0

Forage, water and safe area for breeding and resting are important habitat components for the wild ass. Preference for different habitats differs in all three seasons, though habitats of sparse and medium *Prosopis* cover were used in all seasons in the day as well as at night (Shah, 1993). Distribution pattern will be different, as animals from fringe areas move to agricultural fields at night during winter and summer in search of food and water.

Population Management: The population of wild ass in the Little Rann for long term conservation needs to be well above 2,500 as prescribed by the IUCN/SSC Equuids Specialist Group (Duncan 1992), the minimum viable population for areas where population is confined to one location. Population of wild ass in and around the Sanctuary has already crossed this number. Animals make regular raids in crop fields in winter and summer, causing resentment among farmers. Farmers regularly complain and demonstrate against the loss of crops (cotton, wheat, gram) and this problem is increasing due to increase in population of wild ass, bluebull, and wild boar in and around the villages.

Although the *khur* population is increasing gradually, it may ultimately reach the levels estimated by Ali (1946) in the near future and would become difficult to manage in the limits of the Sanctuary due to the changed conditions. Original vegetation of grass/herbaceous land and sparse thorn forest of indigenous species is now being invaded by *Prosopis chilensis* in major parts of the vegetated zone. This has reduced the availability of food. Moreover, disturbance due to salt panning and transport, target practice by the Indian Army, and livestock grazing, have added to the factors responsible for habitat degradation. It is difficult to maintain the original carrying capacity of the area without improving the habitat and conservation status of the Sanctuary.

As the area has not faced a severe drought or disease after 1987, the population of wild ass has grown annually. Growth trend in the last decade revealed that this annual rate of growth may be the upper limit of population increase for wild ass in the Little Rann, given the long gestation period and other reproductive characteristics. If this trend continues with the absence of a severe drought or disease, the population may exceed 4,000 by 2010 AD. The trend also indicates that the maximum increase of population would be in peripheral villages and dispersal zones, leading to migration into new areas of the Great Rann, Bhal and desert parts of Rajasthan. Bhal may support no more than a moderate population of wild ass, as man-wildlife conflict would become serious when the population increases. *Beyts* and fringe areas support a good number , by accommodating more wild asses in new areas in the Great Rann. Wild ass has already reached the Rajasthan-Pakistan border area. Hence, the Thar Desert in Rajasthan may prove to be important in accomodating excess populations. The time has come to explore the possibility of development of the Thar Desert near the border as an alternative site for the Indian wild ass. As these animals were found in historical times in the desert, their natural dispersal into the original habitat should not be a problem.

Conservation Strategy

In the absence of a settlement and demarcation of the Sanctuary, adequate protection could not be enforced, which resulted in legal disputes and conflicts as various stake-holders claimed right of use of areas. Settlement work is under progress, but it needs to be completed without further delay. Salt preparation continued in the Sanctuary and expanded to new areas in the absence of regulations. About 28.6 lakh tonnes of salt was produced annually (in 1996) and the leased out area in the Sanctuary increased from 166 sq. km in 1973 to 461 sq. km in 1995. Over one thousand vehicles ply everyday in the salt production season, causing serious disturbance to wildlife. Salt panning — salt ponds created for evaporation — should be restricted and regulated within demarcated zones with fixed transport routes. The Army continues to use an extensive leased area of 217 sq. km near Tikar for target practice. Movement of tanks and army activities should be restricted in the demarcated zone. They should not use the *beyts* as targets, but erect concrete pillars (Singh *et al.* 1998).

Invasion of *Prosopis chilensis* should be controlled on *beyts* and in fringe areas. Original habitat conditions should be restored by uprooting this species from some of the areas faster than its invasion rate of 677 ha/year. High density of cattle dung (334/ha) was observed on the northern fringe, followed by 276/ha on the western fringe, 274/ha in western creek area, 194/ha on *beyts* and 170/ha on the southern fringe (Singh *et al.* 1998). Cattle dung density was high in all the zones, indicating intense grazing. Critical habitats, especially those important for breeding, need to be protected from cattle grazing.

Disturbance in the Sanctuary and expansion of agriculture resulted in the movement of wild ass from the Sanctuary to crop fields. The conflict between wildlife and local people is increasing in the fringe area due to crop raiding by wild ass. Land use patterns will change rapidly after irrigation of land from the Narmada canal, which is likely to cause some impact on the ecology of the Sanctuary and its surrounding areas. This should be studied properly by carrying out an environmental impact assessment. Environmental education, habitat improvement and ecodevelopment programmes could be long-term strategies of conservation.

There is no harm in capturing some animals straying into villages to meet the demand of zoological parks. Simultaneously, efforts must be made to find alternative sites for wild ass in the Great Rann, Thar Desert and Bhal area as part of the long-term conservation strategy.

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ANNUAL MOVEMENTS OF A STEPPE EAGLE (*AQUILA NIPALENSIS*) SUMMERING IN MONGOLIA AND WINTERING IN TIBET[1]

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(*With one text-figure*)

Key words: *Aquila nipalensis*, migration, satellite telemetry, steppe eagle

An adult female steppe eagle (*Aquila nipalensis* Hodgson) was captured and fitted with a satellite transmitter in June 1995 in southeastern Mongolia. In fall, it traveled southwest towards India as expected, but stopped in southeastern Tibet and wintered in a restricted zone within the breeding range of the steppe eagle. In spring, the bird returned to the same area of Mongolia where it was captured. These observations, though derived from the movements of a single bird, suggest three things that are contrary to what is generally believed about steppe eagle biology. First, not all steppe eagles move to warmer climes in winter. Second, not all steppe eagles are nomadic in winter. Finally, because our bird wintered at the periphery of the steppe eagle breeding range in Tibet, perhaps birds that breed in this same area also winter there. If so, not all steppe eagles are migratory.

The summer and winter ranges of the western race of the steppe eagle (*Aquila nipalensis orientalis*) have been mapped (Cramp and Simmons 1980). These birds breed from eastern Europe to eastern Kazakhstan and Kirgizia, and winter almost exclusively in Africa. Important migration concentration zones have been located (Welch and Welch 1991) and the migration of 10 birds has been followed by satellite (Meyburg and Meyburg 1995).

Less is known of the migration patterns and winter distribution of the eastern race (*A. n. nipalensis*) (Welch and Welch 1991, Watson 1997: 213). Thousands have been documented moving east-west at mid elevations paralleling the southern slopes of the Himalayas (Fleming 1983, Welch and Welch 1991). There is also some documentation of a trans-Himalayan migration. One was found dead on the south col of Mt. Everest at about 7,925 m (Singh 1961). Many birds have been seen traversing mountain passes in Nepal, with a maximum of about 100 birds per hr on 24 October (Inskipp and Inskipp 1985) and nearly 8,000 seen at one location in less than three weeks (de Roder 1989). Davis and Glass (1951) reported that steppe eagles were seen daily for a two-week period in October at Chihkiang (27.3° N, 110.1° E), Hunan, China.

The eastern race winters broadly across the Indian subcontinent, with a disjunct population in central and southern Myanmar (Smythies 1953, Cramp and Simmons 1980, Welch and Welch 1991). Some birds are mentioned wintering as far north as Nepal (Inskipp and Inskipp 1985). With recent deforestation, the species' wintering range may be expanding southward into and beyond peninsular Malaysia (Helbig and Wells 1990). These authors reported the first observation in Selangor (03.5° N, 101.2° E) in 1987. Further south, they reported single immatures in Singapore and Borneo. Stragglers have been previously reported from Hong Kong, Tenasserim (southern Myanmar: 12.1° N, 99.0° E) (Smythies 1953, King and Dickinson 1975), Viet Nam, and Thailand (Meyer de Schauensee 1984).

To improve our understanding of the migratory movements of eastern steppe eagles,

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we captured an adult female in 1995. This paper reports the movements of that bird over a 15-month period as revealed by satellite telemetry. Satellite monitoring of long-distance movements of flighted birds using the Argos Data Collection and Location System began in 1984 (Strickwerda *et al.* 1986) and is routine today, with transmitter packages (unfortunately dubbed Platform Transmitter Terminals, PTTs) as small as 30 g (and sometimes smaller). These PTTs, with careful programming, can provide data intermittently over the course of a year or more (see overview of system specifications in Meyburg *et al.* 1995).

Methods

As part of a larger study of raptors in Mongolia, in 1995 we focused on finding a steppe eagle eyrie with thermocompetent young, so we could capture and radio tag an adult without jeopardizing the young. We had originally planned to tag a fledgling. However, steppe eagles, which are migratory in Mongolia, nest much later than saker falcons (*Falco cherrug*) and golden eagles (*Aquila chrysaetos*), the primary objects of our study. The result was that during our May to mid-July surveys we were unable to find any nests with young large enough to safely outfit with a backpack harness (it is unsafe to place an adult-size harness on a downy chick).

After one month of searching, on June 26, we found a nest with chicks old enough to survive a mild night without being brooded. The three nestlings were about three weeks of age (based on photos of similarly developed golden eaglets). Although the chicks were much too young to harness, we returned at dusk that same night for an attempt to capture one of the adults. The adult male (dark morph) was roosting on a large boulder *c.* 100 m east of the eyrie: the adult female (pale morph) was on the nest with her chicks. Our plan was to wait until midnight and then try for the male first. Failing that, we would try and capture the female on the nest. From an earlier attempt to capture another roosting male, we knew that these birds would perch in one spot at dusk. Then, after it became too dark for us to see, they would fly to another location. This may be a predator avoidance adaptation of a species that very often roosts on or near the ground, and is thereby highly vulnerable to mammalian predation.

We began our capture attempt from camp, 1.5-2.0 km from the nest. All three persons in the team changed to dark clothing. It was a calm, starlit, moonless night. At 2330 hrs, we began our approach. Without headlights, we very slowly drove our motor vehicle, a Russian (UAZ) four-wheel drive, to within about 70 m of the nest. Then we propped open the hood, directing the engine noises toward the cliff. Next, we adjusted the throttle to about 1,500 rpm so the noise of our on-foot approach would be masked by the engine noises. We circled the hill so our approach would be from the darkest part of the sky. As we began the final approach to the male's roost, the capture person pulled wool leggings over his shoes and moved forward, holding a large (9V) battery-powered flashlight with strobe capability. When we were within 15 m, we began searching the boulder tops with the flashlight, but the male was gone.

Next, we began our approach on the female. At 60 m, we gave a slow series of eagle owl (*Bubo bubo*) hoots to encourage the female to stay on the nest and defend her young. At 10 m the lead person began to strobe the eagle at frequent intervals, to confuse the bird and to illuminate the cliff top. At 3 m, we could see two young in front of the adult, so we concluded that one must be beneath her. When 70 cm away, the flashlight was dropped and the lead person pounced on the eagle, pushing her, breast forward, into the nest but very quickly pulling her legs back beneath her tail so she could not damage the third chick with her talons. After

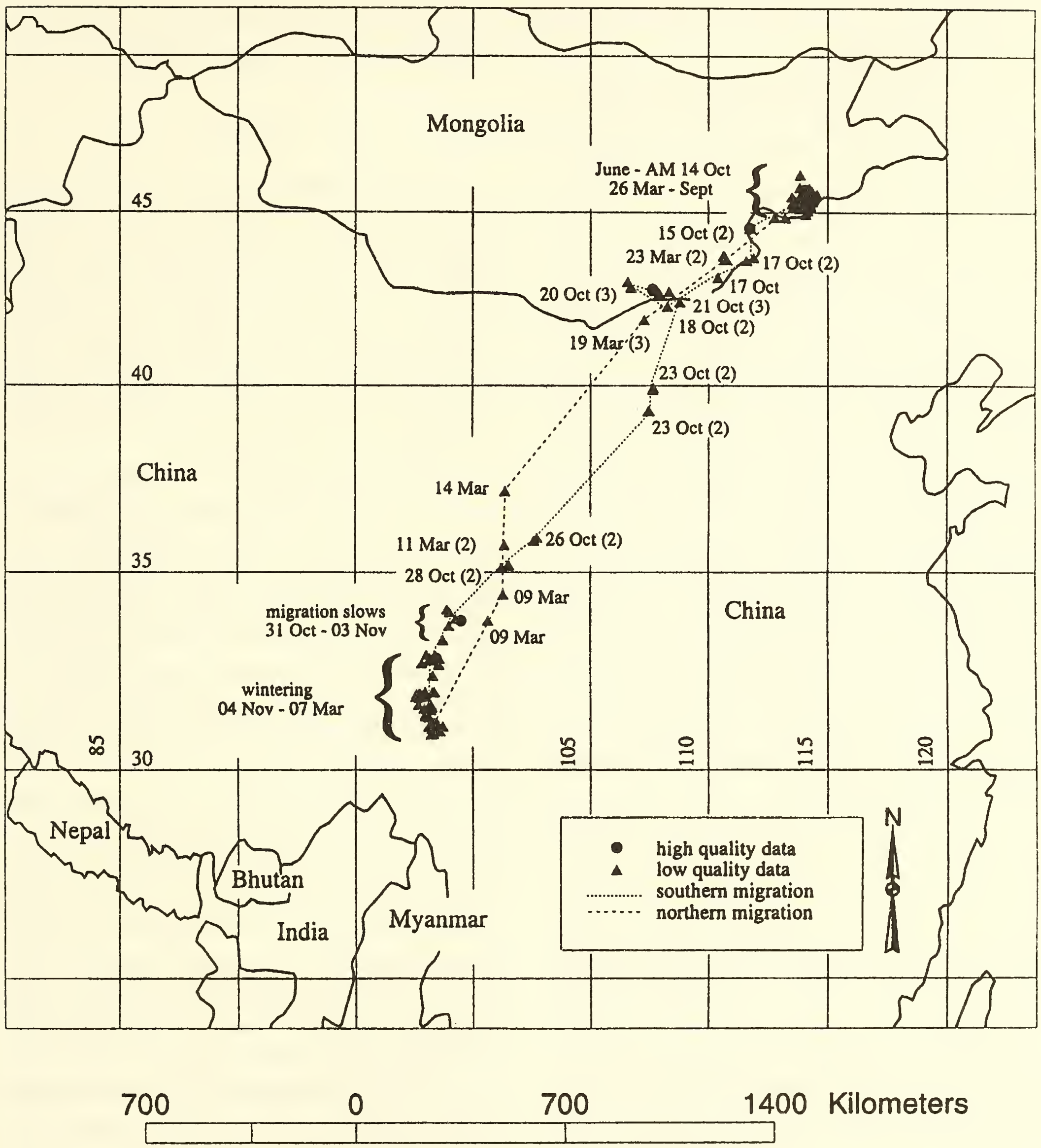

Fig. 1: Year-round (June 1995 to September 1996) movements of an adult steppe eagle. Numbers in parentheses following some dates indicate the number of satellite fixes for each location. Each fix is based on two (and usually more) location estimates. If the number of fixes is not provided for points along the migration route, assume one. Number of fixes is also not provided for termini and stopover locations where veracity of location is established by many points.

the female was lifted from the nest, we checked the chicks and saw that none were wounded during the struggle.

During the night, we attached the PTT, then socked the eagle to release her in the morning. By 0545 hrs on June 27, we were preparing the eagle for release. We cleaned her soiled ventral plumage with a water gun (Super Soaker), then decided to also wet her dorsal surface to discourage flight. In the 13th century C.E., Frederick II, Holy Roman Emperor, illustrated the ancient falconry technique of wetting a restive falcon's plumage to inhibit bating — a falconry term for a raptor's attempt to fly free (Wood and Fyfe 1969). At *c.* 0700 hrs, we placed her on the nest near the eaglets and sprayed her with more water. Then, with her legs still stretched out behind and a loose layer of paper over her head, we released her and crept silently to the car. We rolled the car, with engine off, down the hill away from the eyrie, then at 0741 hrs drove the car over the horizon: the female was still on the nest. At 1040 hrs, we returned to the area and using a telescope from a distant vantage point saw the female standing on the nest near her young.

Wishing to see if the eagle was encumbered by the harness, we returned at about 1400 hrs on June 28. The female was shading her chicks and allowed us to closely approach the eyrie before she flushed. When she flew, the radio was visible on her back, but she flew without any noticeable impediment.

The PTT used in the study was a 95 g unit manufactured by Microwave Telemetry, Inc. It measured 94 x 33 x 30 mm with a rearward projecting 216 mm antenna. The harness was a fall-free, crossed double loop of Teflon-coated nylon ribbon (13 mm wide) as described by Olsen *et al.* (1992 and unpubl. data). The PTT was programmed for four different transmission "seasons" as follows: Season 1, June 25 to September 1, 8 hrs on each 4.6 days; Season 2, September 1 to December 15, 8 hrs on each 1.6 days; Season 3, December 15 to February 1, 8 hrs on each 4.6 days; Season 4, February 1 to exhaustion, 8 hrs on each 2.6 days.

Results

For presentation here, we divided our location data points (fixes) into two quality classes. Higher quality fixes are believed to be within 1 km of the true location. Lower quality fixes (i.e. data derived from fewer or weaker signals), while of uncertain accuracy when treated individually, often provide very good approximations of the true location when two or more fixes are in one small area.

From our single PTT, we obtained 461 fixes of which 53 (12%) were high quality. The data track in Fig. 1 provides much useful information and some surprises. First, the wintering area used by our bird, extreme eastern Tibet, is north of the known wintering range for this subspecies in eastern Asia. Inskipp and Inskipp (1985) reported steppe eagles wintering in Nepal, but we know of no prior record of steppe eagles wintering in Tibet.

Our bird spent the period from November 4 to March 7 in the pre-cordilleran plateau between the Mekong and the Yangtze rivers. Although the summering area of this eagle in Mongolia was an area of high volcanic hills scattered across a level steppe at about 1,350 m elevation, her wintering area was a region of high ridges (up to about 4,000 m) and valleys (as low as 2,700 m) dominated by alpine meadow soils and covered with subalpine scrub and cold steppe with few forest patches. Nearby peaks rise to 4,300-4,600 m. Judging by elevation, the winter climate in Tibet would have been at least as harsh as if the bird had remained on the summering area in Mongolia.

Movements of the bird in her wintering area are also of interest. She arrived in the general area between October 28 and October 31, and settled into a rather restricted zone for

several days. Then she moved south approximately 100 km to spend the remainder of the winter in a narrow corridor about 300 km long. Although this area is large compared to the home range of a breeding eagle, it is small when compared to the movements of steppe eagles wintering in Africa (Watson 1997). There, they charac-teristically make repeated long distance movements as they search for termites which appear after rainstorms. Watson (1997: 99) placed the steppe eagle in the group of raptors characterized by nomadic, wide-ranging winter movements in search of abundant, but transient food. Our bird's movements were much more focused, suggesting that it was surviving on a food supply very different from that used by steppe eagles wintering in Africa.

Another temporal feature of interest is that the fall migration was more leisurely than the spring migration. The bird departed from the breeding area sometime after noon on October 14, and traveled rather leisurely for four days to an area about 600 km southwest. She remained there from October 18 to 21 or 22, then traveled rapidly for the last 10 days of October. Her general wintering area was about 1,350 km southwest of the fall "staging area" and about 2,000 km from the breeding area. Here again, the eagle paused for a few days (October 31 to November 4) and then moved south to the zone where she spent the winter (November 4 to March 7). Her northward journey began between March 7 and 9. By March 26, the bird arrived in the region where it had been captured the previous summer. No staging or stopover sites were observed on the northward trek. Gross rate of travel comparisons using median dates of arrival and departure are as follows:

Fall migration (total distance: 1,800 km), 20 days (October 14½ to November 3½): 90 km/day.

Spring migration (total distance: 2,200 km) 16½ days (March 8 to March 24½): 133 km/day.

Discussion

From this single bird, we learn: first, that although steppe eagles purportedly wander widely in winter, our eagle's winter range was restricted. Second, the winter range of the eastern race of the steppe eagle is purported to be India and Burma, with some birds in Nepal and stragglers south into peninsular Malaysia. Our bird wintered in extreme eastern Tibet at the periphery of the known breeding range of the steppe eagle. The steppe eagle is described as being entirely migratory (Cramp and Simmons 1980: 218, Welch and Welch 1991, Clark 1992), but because our bird wintered where or near where Tibetan birds breed, it is likely that some Tibetan birds winter in this same area and are, as a result, non-migratory. We urge that these novel ideas be explored by the deployment of more satellite transmitters on adult eagles in Mongolia and Tibet.

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BREEDING ECOLOGY OF ANNANDALE'S TREE FROG *CHIRIXALUS SIMUS* (ANURA: RHACOPHORIDAE) NEAR KOLKATA, WEST BENGAL[1]

KAUSHIK DEUTI[2]

(*With one plate*)

Key words: Amphibia, *Chirixalus simus*, arboreal foam-nest, breeding ecology, insolation, desiccation

The breeding ecology of the Annandale's tree frog (*Chirixalus simus*) was studied in a 340 sq. m marsh at Rajpur, West Bengal. The results showed that the species is an early breeder, breeding in the first month of monsoon. Most foam-nests are constructed on grass, in the first two weeks, 6-58 cm above standing water and contain 153-234 eggs. The size of the foam-nests depends on their position on the grass where the frogs mate. The nests are located 10-807 cm away from dry land. It has been speculated that different species of the genus show a preference for land over water for constructing foam-nests.

INTRODUCTION

Chirixalus is a genus of small to medium-sized Old World tree frogs (Anura: Family Rhacophoridae) widely distributed from Japan to India and is known from nine nominal species (Frost 1985). Although there are some accounts on the morphology of the genus, not much is known about the reproductive biology. Most *Chirixalus* species are believed to construct arboreal foam-nests, from which tadpoles drop into ponds and ditches soon after hatching. *Chirixalus nongkhorensis* of Thailand and China constructs foam-nests on the surface of pond water (Duellman and Trueb 1986). *C. idiootocus* of Taiwan lays eggs on land, near the edge of water without making a foam-nest. Hatching is apparently stimulated by rain and tadpoles spend a typical aquatic life in ponds or rain pools (Kuramoto and Wang 1987). Ecological data on the breeding habits of the genus *Chirixalus* is lacking. In this paper, I report the breeding ecology of *Chirixalus simus* during June to September 2000, at a site near Kolkata, West Bengal, India.

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[2]Zoological Survey of India, Prani Vigyan Bhavan, 535, M-Block, New Alipore, Kolkata 700 053, West Bengal, India.

MATERIAL AND METHODS

The study site was located in a marshy area at Rajpur (22° 20' N, 88° 35' E), South 24 Parganas district, West Bengal, 6 km south of Kolkata in September, 1999 (Deuti *et al.* 2000). A plot of 340 sq. m (20 x 17 m) was marked off. The plot has a waterhole of 24 sq. m (6 x 4 m) in one corner with grass (*Saccharum spontaneum*), banana (*Musa paradisiaca*) plantations on two sides, a village road on the third and a high concrete boundary wall of a residential building on the fourth. The plot, including the waterhole, dries up completely during summer, and the grass is cropped short by grazing cattle. With the advent of monsoon, the plot gets waterlogged, the grass grows up to 2 m and flowers. The frogs, which hide in the sheaths of the banana plants during summer, arrive at the plot to feed and breed on the grass, constructing foam-nests.

Throughout the monsoon, from mid-June to mid-September, the plot was visited twice a week and the number of foam-nests, their measurements, distance from dry land, height above ground and water-level, and maximum depth of water in the plot were measured. Daily atmospheric temperature, relative humidity and rainfall data were obtained from the Alipore meteorological station, Kolkata, and the data on

number of foam-nests and depth of water in the plot were tabulated with the weather parameters (Table 1). The mating calls were recorded and photographs of breeding pairs and foam-nests taken. The plot was sampled every three days to allow the foam-nests counted earlier to dissolve and let the tadpoles escape into the water. This prevented re-counting and measuring of the same foam-nests. Some foam-nests were collected during different times of the breeding season to determine the clutch-size.

Results

In 2000, the monsoon commenced a little late in southern West Bengal. There was negligible rain from mid-June to mid-July, the plot remained dry and there was very little water in the waterhole. Only a few individuals of *Hoplobatrachus tigerinus* were heard calling at the plot on June 22, when there was a sudden cloud burst, producing 69 mm of rain, but they could not breed as the rain water quickly seeped into the ground. On July 7, 2-3 male *Polypedates maculatus* arrived at the plot and started calling, but no females were sighted. The first week of July was dry, without any precipitation. From July 9, it rained daily and by July 11, it was apparent that the monsoon had finally set in. Water started accumulating in the plot from July 12. By July 14 there was 5 cm of water in the plot and the first males of *Chirixalus simus* had arrived and started calling. The first females arrived only on July 16.

On July 17, four pendulous foam-nests were observed on the grass (Table 1). When the water level at the plot increased to 11 cm on July 22, due to substantial rain everyday, the breeding activity of the frogs peaked to 34 foam-nests, gradually decreasing to none by August 18. Due to heavy precipitation each day, the water level increased further to 42 cm and 58 cm on July 24 and July 26 respectively. However, the number of foam-nests decreased to 11 and 6, respectively. As the water level at the plot decreased during the next two weeks to 26 cm by August 13, the frogs constructed fewer numbers of foam-nests. After that as the water-level decreased further to

Table 1

BREEDING PATTERN OF *CHIRIXALUS SIMUS* AT THE STUDY PLOT

Date of Observation	Max depth of water (cm)	Number of foam-nests	Rainfall on previous day (mm)	Max & Min. temp. on previous day (°C)	Max & Min R.H. on previous day (%)
14.07.2000 (first frog arrived)	5	0	16.0	32.2-25.9	97-75
17.07.2000	6	4	11.1	32.8-27.0	97-73
19.07.2000	8	9	34.6	27.1-24.9	98-74
22.07.2000	11	34	25.7	27.0-26.4	98-85
24.07.2000	42	11	62.8	27.4-24.9	98-76
26.07.2000	58	6	12.4	29.9-25.4	97-76
29.07.2000	39	3	7.0	32.3-26.0	98-69
02.08.2000	33	2	13.0	32.5-25.2	97-75
07.08.2000	28	1	31.7	34.3-27.9	97-72
10.08.2000	30	1	11.3	32.4-27.5	94-73
13.08.2000	26	1	29.9	28.3-26.3	98-92
18.08.2000	23	0	56.3	32.9-26.2	98-79
25.08.2000 (froglets seen on grass)	15	0	0.2	34.0-27.2	94-67
30.08.2000	0	0	0.4	32.4-27.5	95-75
02.09.2000	22	0	20.5	31.8-25.3	98-70
08.09.2000	38	0	11.2	30.0-26.1	98-87
14.09.2000	13	0	0.2	32.4-26.2	97-71

Deuti, Kaushik: *Chirixalus simus* PLATE 1

Fig. 1: Foam-nest of *Chirixalus simus*

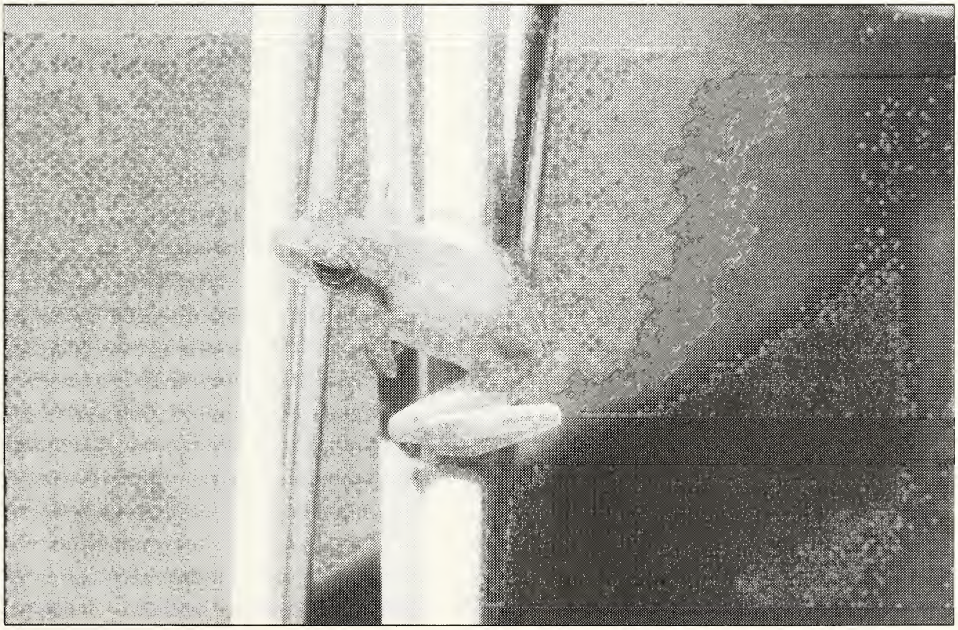

Fig. 2: *Chirixalus simus* at Rajpur, West Bengal

0 cm (no standing water at all) on August 30, there were no more foam-nests. Tiny froglets (snout-vent length: 9 mm) were seen clambering on to the grass on August 25, tadpoles of the first foam-nests had metamorphosed. In September, there was some more rain and the water level at the plot increased to 38 cm on September 8, but though other atmospheric conditions were suitable for breeding, no more foam-nests were constructed. The breeding was over by mid-August, though some males were still calling in the plot till mid-September.

Of the 72 foam-nests observed, 22 were measured. Length of the foam-nests varied from 5.2-7.3 cm ($\overline{X}$ = 6.06, SE = ±0.15), breadth from 1.9-3.6 cm ($\overline{X}$= 2.77, SE= ±0.10) and thickness from 1.6-2.8 cm ($\overline{X}$= 2.27, SE= ±0.08). The foam-nests were constructed on grass, 17-89 cm above the land ($\overline{X}$= 48.61, SE= ±4.87) and 5-64 cm above the water level ($\overline{X}$= 31.5, SE= ±3.91). The depth of the water in the plot ranged from 4-46 cm ($\overline{X}$= 17.11, SE= ±2.76). The foam-nests were constructed 10-807 cm from the nearest dry land ($\overline{X}$= 231.9, SE= ±35.81). Six foam-nests collected contained 192, 164, 212, 234, 216 and 153 ($\overline{X}$= 195) eggs.

Discussion

From these observations, it is apparent that *Chirixalus simus* is an early breeder. Breeding activity starts with the arrival of the monsoon and continues for about one month, but most of the breeding and foam-nest construction occurs within the first two weeks. Thereafter, 1-2 foam-nests may be constructed. The frogs exhibit sporadic rain linked breeding (i.e. they breed sporadically after heavy rains). Anurans in tropical areas breed only when the rainfall is sufficient to provide oviposition sites (Duellman and Trueb 1986). In *C. simus*, some rain (11-63 mm) is required to initiate breeding activity, as there must be some standing water (4-46 cm) at the base of the grass for construction of the foam-nests. It was observed that temperatures of 25-33 °C and relative humidity of 73-98% are required for breeding. The measurements of the foam-nests depend on their position on the grass where the frogs mate and lay eggs. The clutch size varied from 153-234 eggs.

Foam-nest construction has evolved independently in five anuran families: Leptodactylidae, Myobatrachidae, Rhacophoridae, Hylidae (in a few species) and Hyperolidae (in a single species, *Opisthothylax immaculatus*). Foam nesting species have evolved from aquatic to terrestrial environments. This route may have been through the evolution of a foam-nest (Heyer 1969) whose main function seems to be that of protecting eggs and larvae against desiccation (Hodl 1986), and thermal damage as white foam reflects heat (Gorzula 1977). In the light of this information, I speculate that the construction of foam-nests in *Chirixalus* has evolved mainly for protection against desiccation and insolation of eggs and embryos. The route from aquatic to terrestrial habitats in the different species of the genus *Chirixalus* has progressed from *C. nongkhorensis* of Thailand which constructs foam-nests on the surface of water, through *C. simus* and *C. dudhwaensis* of India, which construct foam-nests hanging from grass over temporary water to *C. vittatus* of Myanmar and Thailand, which constructs gelatinous foam-nests on the surface of grass blades growing at the edge of water, ultimately to *C. idiootocus* of Taiwan, which lays eggs on land near water without forming a foam-nest.

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A CATALOGUE OF THE BIRDS IN THE COLLECTION OF THE BOMBAY NATURAL HISTORY SOCIETY — 39. PLOCEINAE AND ESTRILDINAE[1]

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(Contd from *JBNHS* 97(2): 234)

This part covers 386 specimens belonging to 23 species and subspecies up to Synopsis no. 1978a, in the HANDBOOK (Vol. 10, p. 120) and 2 extralimitals. We do not have specimens for 2 subspecies in the Collection.

1957 ***Ploceus philippinus philippinus*** (Linnaeus) (Philippines, *errore* - Ceylon). Baya weaver 3: 67

55: 29 males, 20 females, 6 unsexed.

1 Simla Hills, 1 Kesarvala, Dehra Dun, 4 Jagadri, Ambala, 2 Delhi, Meerut, 1 Bharatpur, 1 Hamavas lake, Pali Dt, 1 Chobari, Bhachan Dt, Kutch, 4 Changalra, 1 Bhuj, 2 Cambay City environs, Gujarat, 1 Mumbra, 1 Wada, 1 Thana, 1 Andheri, 1 Santacruz, 1 Borivli, 1 Caves, Salsette, 2 Powai lake, 1 Tulsi lake, 2 Jogeshwari caves, Salsette, 1 Karjat, 3 Poona, Deccan, 1 Satara, 1 Molem, Goa, 1 Karwar, 2 Kalai, Trichinappally, 1 Kurumba patty, Salem Dt, 3 Kumbum Valley, Kurnool Dt, 2 Kondila, Khandhara, 1 Barkul, Chilka lake, 1 Baramba, Orissa, 1 Dodi, Malwa, Bhopal, 2 Sonarpur, 2 Rudrapur, UP, 1 Calcutta market, 2 Baghownie, Tirhut.

Out of the 29 males, 15 are in full breeding plumage. One male in the month of May from Baghownie Tirhut, one in June from Poona, one each in July from Karwar, Karjat, Borivli, Andheri, 2 from Kalai, 1 from Trichinappally, 2 from Jagadri; in August 1 male each from Rudrapur, Meerut and Simla Hills and in September 2 males from Changarla Bhuj are breeding males.

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Regn. No. 21228, an unsexed specimen from Poona presumably kept as a cage bird from 1958 to 1959, is very dark on the whole with an almost black head.

Measurements on p. 350.

1958 ***Ploceus philippinus travancoreensis*** Whistler (Kottayam, Travancore). Baya weaver 3: 67

2: 1 female, 1 unsexed.

1 Cherpu, Trissur, 1 Kuttani, Trivandrum, Kerala.

Measurements on p. 350.

The British Museum (Natural History), Tring, U.K. has five specimens, four males (1 juvenile) and a female, collected by Salim Ali and N.G. Pillai during the Travancore State Ornithological Survey in 1933. The localities are 1 Wadakkancheri, Trissur, 2 Backwaters, Kottayam, 1 Kuttani, 1 Cattle farm, Trivandrum.

The type specimen is a male moulting into breeding plumage (see note on page 453).

1959 ***P.p. burmanicus*** Ticehurst (Akyab). Baya weaver 3: 70

13: 9 males, 3 females, 1 unsexed.

2 Calcutta market, 1 Manjhaul, Monghyr Dt, Bihar, 1 Crawford Market (from Nepal), 1 Hasimara, 1 Rajabhatkawa, Duars, Jalpaiguri Dt, 1 Ronikata camp, Goalpara, 1 Dibrugarh, Assam, 1 *Maymyo, Mandalay Dt, U. Burma, 1 Ngaphaw, Prome Dt, 3 Mindon Chaung, Thayetmyo Dt, C. Burma.*

Most of the specimens of this group were wrongly identified.

There are four breeding males, one each from *Maymyo* (22.viii.1913), Calcutta market (5.vi.1900), Calcutta market (no date, brown bill) and Jalpaiguri (vi.1918). Three of them have black bills. All have golden yellow crown, but

do not have yellow breast like *phillippinus.* Yellow and deep brown streaks on the back of the nominate race is replaced by fulvous and brown streaks. The statement in the HANDBOOK (Vol. 10, p. 93) that the normal breeding plumage is largely suppressed, seems to be incorrect.

Measurements on p. 350.

1960 ***Ploceus megarhynchus megarhynchus*** Hume (Terai = Kaladoongi [sometimes Kaladhungi], below Naini Tal). Baya weaver 3: 69

23: 13 males, 9 females, 1 unsexed.

6 Bilaspur, 3 Rudrapur, Kumaon, 6 Calcutta market, 6 Crawford market, 1 Bombay zoo, 1 Agia, near Goalpara, Assam.

Regn. No. 19708, a male from Calcutta market has a blackish-brown gorget at the breast.

Larger with bigger bill than *philippinus,* back dark brown, rump deep yellow and lower back with brown and yellow streaks. Whole underpart, from chin to vent, is deep golden yellow. In non-breeding plumage very similar to *philippinus* except for larger size and bill. *philippinus* has head finely and sharply streaked and in *megarhynchus* the streaks are very faint.

Measurements on p. 350.

1960a ***P.m. salimalii*** Abdulali (Bhutan Duars). Finn's baya 3: 69

6: 3 males, 3 females.

3 Bhutan Duars, 2 Rajabhatkawa Duars, 1 Hasimara T.E., Jalpaiguri.

The key in the HANDBOOK (Vol. 10, p. 93) separating the two races seems to be incorrect, refer *JBNHS*, 57: 660. A female Regn. No. 6930, 26.vi.1925 has sharply streaked head like *philippinus*, but the larger bill makes it *megarhynchus.*

Measurements on p. 350.

1961 ***Ploceus benghalensis*** (Linnaeus) (Benghala). Black-breasted weaver 3: 72

24: 12 males, 10 females, 2 unsexed.

1 Chak Sukkur, 1 Jagadri, Ambala, 6 Rudrapur, Kumaon, 1 Sonaripur, Kheri Dt, 1 Sait, Kaira Dt, 1 Ajwa, Baroda, Gujarat, 4 Bombay market, 4 Patancheru, Medak Dt, Andhra Pradesh, 1 Benares, 1 Tirhut, 1 Darbhanga, 1 Mongyr Dt, 1 Margherita, Assam.

Measurements on p. 350.

The British Museum (Natural History), Tring has 94 specimens in their Collection including a breeding male from Bhandup, collected by A.O. Hume, the only record of this species for Bombay (=Mumbai). 20 male specimens are in full breeding plumage, 3 with white throat and face. Their localities extend from Upper Sind and NW India to Dibrugarh and Manipur (18 specimens).

There is confusion regarding the male breeding plumage of the species (*JBNHS*, 96: 187-194), and to clarify the issue DNA fingerprinting was carried out. I collected birds from Dehra Dun, Banaras, Bihar and Hyderabad in Andhra Pradesh and worked out their molecular systematics in Dr. Lalji Singh's laboratory at the Centre for Cellular and Molecular Biology (CCMB), Hyderabad, with some very interesting results, which will be published separately.

1962 ***Ploceus manyar flaviceps*** Lesson (Pondicherry). Streaked weaver 3: 73, 74

11: 9 males, 2 females.

2 Bahawal Nagar, Bahawalpur, 4 Jagadri, Ambala, 3 Rudrapur, Kumaon, 2 Bombay market.

Three males are in full breeding plumage. Heavy streaks on the breast are characteristic of this species.

Measurements on p. 350.

1963 ***Ploceus manyar peguensis*** Baker (Pegu). Streaked weaver 3:75

8: 5 males, 2 females, 1 unsexed.

1 Ragagon, 3 Dibrugarh, 1 Assam, *2 Kamaing, U. Burma 1 Prome, C. Burma.*

No breeding male among them. As the key in the HANDBOOK (Vol. 10, p. 98) suggests these birds are appreciably darker than *flaviceps.*

Measurements on p. 350.

EL ***Ploceus hypoxanthus hymenaicus*** Deignan, Central Siam. Golden weaver bird

2: 1 male, 1 female.

The male is in non-breeding plumage. Both collected by J.K. Stanford from Prome, Burma on January 20, 1929.

Measurements on p. 351.

1964 ***Estrilda amandava amandava*** (Linnaeus). (Eastern India, restricted to Calcutta, West Bengal, by Baker). Red munia 3: 96

29: 18 males, 7 females, 4 unsexed.

1 Pithoro, Sind, 1 Jagadri, 1 Ambala, Punjab, 2 Delhi, 3 Meerut, 3 Hamawas lake, Pali Dt, 2 Jajja Abbasian, Bahawalpur, 4 Bhavnagar, Gujarat, 1 Murbad Road, Thana, 3 Bombay market, 2 Utnoor, Asifabad, Hyderabad, 2 Band, Orissa, 1 Chota Dungar, Basfar Dt, 1 Jaithari, Bhopal St, 1 Sarun, Bengal, 1 Goalpara, Assam.

Measurements on p. 351.

EL ***Amandava amandava flavidiventris*** (Wallace) (Timor & Flores). Burmese red munia

2: 1 male, 1 unsexed.

Both collected by J.K. Stanford from Henzada district of Burma in 1931.

1965 ***Estrilda formosa*** (Latham) (India). Green munia 3: 94

12: 5 males, 4 females, 3 unsexed.

1 Ganga Sagar, 2 Dediapada, Palanpur State, Gujarat, 2 Chikalda, Berar, 1 Kolkas, Melghat, Amravati, 1 Bailadila, Bastar district, 2 Sankrametta, 1 Valasapalli, Sileru, Vizag, 1 Cage bird (Bombay market), 1 no locality.

According to the HANDBOOK (Vol. 10, p. 103) and Grimmet *et al.* BIRDS OF THE INDIAN SUBCONTINENT, p. 827, females have fewer, obsolete bars or less prominent grey and white barrings.

We have five specimens (two males, two females and one unsexed) in adult plumage. The females and males are very similar in plumage including the blackish grey and white barring of the flanks. 42 specimens were examined in the Natural History Museum at Tring (British Museum). The barring on the flanks of 5 females is as bright as those of the males. All of them cannot be wrongly sexed birds and further research is required to reach a conclusion regarding their plumage.

Measurements on p. 351.

1966 ***Lonchura malabarica malabarica*** (Linnaeus) (India). White-throated munia 3: 89

45: 22 males, 17 females, 6 unsexed.

3 Chitral, 1 Campbellpur, 1 Ambala, Punjab, 1 Hushwar Bagh, 2 Sitoni, Gidam, Kalat, Baluchistan, 1 Karachi, 1 Harunabad, Bahawalpur, 1 Delhi, 1 Meerut, 1 Kanpur, 2 Hamawas lake, Pali district, 1 Bharatpur, 1 Gwalior, 2 Jaithari, Bhopal, 1 Chanduva, 1 Bhuj, Kutch, 1 Bodeli, Baroda district, 1 Bhavnagar, 1 Golana, Camba, 1 Nasik, 1 Borivli, 1 Santacruz, 1 Juhu Salsette, 1 Sion mudflats, 1 Colaba, 3 Bombay, 1 Uran, Bombay harbour, 2 Satara, 1 Cumbum valley, Kurnool district, 2 Kodura, S. Cuddappa, 1 Wangalu Tank, Kavur, Nellore, AP, 1 Madras market, 1 Trichinapally, 1 Sarun, Bengal, 1 Nahar, Madhubani, 1 Wahir, 25 m SW of Khojdar.

Larger size, light brown upperparts and a buff throat separate these birds from *striata* which also has a whitish rump, but blackish-brown upper parts.

Measurements on p. 351.

1967 ***Lonchura striata acuticauda*** (Hodgson) (Nepal). White-rumped munia 3:84

18: 8 males, 8 females, 2 unsexed.

1 Ranibaug, Kumaon 1 Karnprayag, Garhwal, 1 Hai Bum, 1 Honka, W. Bhutan, 3 Singtam, Teesta Valley, 2 Dibrugarh, Assam, *1 Singaling, Kyaukse district, 1 Loi Wong, 1 South Shan States, 2 Thayetmyo, 1 Pyaung chaung, 1 Hurran village, Thayetmyo district, 1 Maymyo, Mandalay district, 1 Kyibin, Henzada district, Burma.*

The fine streaks on the abdomen which separate this race from the rest are very faint or absent in some specimens. But it is not difficult to tell them apart in hand from *striata*, *semistriata* and *fumigata* with white abdomens.

TABLE 1

MEASUREMENTS OF THE BIRDS IN THE COLLECTION OF BNHS

	Wing (mm)	Bill (mm)	Tarsus (mm)	Tail (mm)
	1957-1959 *Ploceus philippinus* subsp.			
Males				
1957 *philippinus* (29)	67-76 av. 71.2	15.5-18 av. 16.7	19-22 av. 20.6	41-50 av. 45.4
	(IH 70-77	from skull 17-20	19-22	43-52)
1959 *burmanicus* (9)	71-76 av. 74	16.8-18.3 av. 17.5	21-23.2 av. 21.8	46-52 av. 48.8
	(IH 72-78	from skull 18-20	-	49-53)
Females				
philippinus (21)	60-69 av. 63.8	14-2-17.2 av. 15.4	18-21.5 av. 19	40-49 av. 41.6
	(IH 66-74	from skull 17-20	19-22	41-51)
1958 *travancoreensis* (1)	66	14	20.5	42
	(IH 73	from skull 20	20	-)
burmanicus (3)	69,70,71	17.5, 17.7, 18.9	20.6, 21.5, 22.5	44,46, 48
	(IH 70-76	from skull 17-19	-	44-49)
	1960 and 1960a *P. megarhynchus* subspp.			
Males				
1960 *megarhynchus* (12)	75-82 av. 78.5	19.3-21.7 av. 19.2	22-25 av. 23.7	49-60 av. 55.3
	(IH 69-80	from skull 22-23	25	56-60)
1960a *salimalii* (3)	76, 77, 83	17.5, 17.9, 21.5	22, 22.5 (2)	50, 52, 59
	(IH 80-82	from skull *c.* 20	23-26	57-59)
Females				
megarhynchus (9)	70-78 av. 74.1	17-20.8 av. 18.8	21-24 av. 22.7	48-55 av. 51.6
	(IH 66-74	from skull 21	24	54)
salimalii (3)	70, 74, 77	17.5, 18.5, 19.5	21.7, 22, 22.5	44, 53, 54
	(IH 76-77	from skull *c.* 20	23-24	*c.* 55)
	1961 *Ploceus benghalensis*			
Males 12	63-72 av. 68.9	15.5-17.5 av. 16.4	19.2-21.5 av. 20.6	39-45 av. 41.5
	(IH 69-75	from skull *c.* 16	*c.* 21	38-45)
Females 9	67-71 av. 68.7	13.5-16.7 av. 15.4	18.5-22 av. 20	40-43 av. 41
	(IH 65-72	from skull *c.* 16	*c.* 21	38-45)
	1962-63 *Ploceus manyar* subspp.			
Males				
1962 *flaviceps* (7)	71-74 av. 72	15.5-17.5 av. 16.4	19.5-21.4 av. 20.6	43-46 av. 44.7
	(IH m/f 66-72	from skull *c.* 18	21-22	41-44)
1963 *peguensis* (5)	68-73 av. 71.6	15.5-16.7 av. 16.2	19-22 av. 20.9	43-48 av. 45.6
Females				
flaviceps (2)	68, 70	15,16	20, 21	40, 43
	(IH as in 1962)			
peguensis (2)	66, 70	15.5, 16.3	18.7 (2)	38, 42

TABLE 1 (*contd.*)
MEASUREMENTS OF THE BIRDS IN THE COLLECTION OF BNHS

	Wing (mm)	Bill (mm)	Tarsus (mm)	Tail (mm)
	EL *Ploceus hypoxanthus hymenaicus*			
Male (1)	69	14.5	20.5	54
Female (1)	70	14.2	20.5	52
	1964 *Estrilda amandava*			
Males (17)	46-49 av. 47.6 (IH 47-50	9-10 av. 9.3 from skull 9-11	13-15 av. 13.6 12-13	33-39 av. 36.1 35-40)
Females (7)	46-50 av. 47.2 (IH 47-50	8.5-9.8 av. 9.2 from skull 9-11	13-14.5 av. 13.7 12-13	33-38 av. 35.2 34-39)
	EL *Amandava amandava flavidiventris*			
Male (1)	45	7.5	12.5	36
	1965 *Estrilda formosa*			
Males (5)	47-49 av. 48 (IH 46-51	8.5-10.5 av. 9.8 from skull 10-11	13-15 av. 13.8 13-15	35-38 av. 36 34-39)
Females (4)	47-49 av. 48 (IH 46-50	8.9-10 av. 9.3 from skull 10-11	13.5-14 av. 13.8 13-15	36-38 av. 36.5 35-39)
	1966 *Lonchura malabarica malabarica*			
Males (22)	52-58 av. 54.6 (IH 53-58	8.5-11 av. 9.8 from skull 10-11	13-15 av. 13.8 13-15	36-53 av. 44.8 39-56)
Females (17)	52-56 av. 54 (IH 53-57	9-10 av. 9.7 from skull 10-11	13-14.5 av. 13.6 13-15	36-48 av. 43.5 41-50)
	1967-1970 *Lonchura striata* subspp.			
Males				
1967 *acuticauda* (8)	50-55 av 51.5 (IH 49-55	9.6-10.5 av. 10.2 from skull *c.* 12	13.5-15 av. 14 14-15	37-44 av. 39.4 38-46)
1968 *striata* (11)	52-54 av. 53 (IH 51-56	10.5-12 av. 11.1 from skull 12-14	13.5-14.5 av. 13.8 13-14	35-40 av. 37.5 35-42)
1969 *fumigata* (2)	50, 51 (IH m/f 48-51	9.6, 10 -	14, 14.5 13-14	38, 41 42-45)
1970 *semistriata* (5)	47-50 av. 48.8 (IH m/f 48-51	9.2-11 av. 10.2 -	12.5-15 av. 13.8 13-14	32-38 av. 35 38-40)
Females				
acuticauda (8)	48-54 av. 51 (IH 51-54	10-11.3 av. 10.5 from skull *c.* 12	13-14.2 av. 13.8 14-15	38-44 av. 40.1 *c.* 40)
striata (7)	51-56 av. 53.5 (IH 53-57	10.5-11.6 av. 11.2 from skull 12-14	13.5-15 av. 14.2 13-14	36-40 av. 38.5 35-39)

TABLE 1 (*contd.*)
MEASUREMENTS OF THE BIRDS IN THE COLLECTION OF BNHS

	Wing (mm)	Bill (mm)	Tarsus (mm)	Tail (mm)
Females				
fumigata (1)	51	10.5	13.5	42
semistriata (4)	47-49 av. 48.2	10-10.6 av. 10.2	13-14 av. 13.5	32-40 av. 35.2
	1971, 1972 *Lonchura kelaarti jerdoni*			
Males (3)	56, 57 (2) (IH 56-59	12.2, 12.5, 12.7 from skull 13-14	13.8, 14, 15 14-15	35, 37 (2) 37-43)
Females (4)	55-57 av. 55.7 (IH 57-59	11-12 av. 11.5 from skull 13-14	14-15 av. 14.4 14-15	36-40 av. 37.2 36-39)
	1974-75 *Lonchura punctulata* subspp.			
Males				
1974 *punctulata* (28)	52-57 av. 55.7 (IH 54-58	10-12 av. 11 from skull 12-13	11-16 av. 14.6 14-16	34-42 av. 37.2 32-45)
1975 *subundulata* (3)	53, 55, 56 (IH measurements	7.5, 11.7 (2) as in 1974)	14.4, 15.5 (2)	34 (2), 40
Females				
punctulata (15)	54-59 av. 55.2 (IH 53-59	9.5-12 av. 11.3 from skull 12-13	14.5-16.5 av. 15.3 14-16	33-40 av. 36 33-45)
subundulata (3)	53 (2), 55	10.5, 10.8 (2)	14.5, 14.9, 15	32, 35, 39
	1976-78 *Lonchura malacca* subspp.			
Males				
1977 *atricapilla*	53 (2), 54, 55 (Baker m/f 53-59)	10, 10.5 (2), 11	13.7, 16 (3)	31, 32 (2), 33
1978 *malacca* (11)	50-59 av. 55.4 (IH 55-59	10.5-12 av. 11.6 from skull 13-14	15-16.5 av. 15.8 *c.* 16	30-39 av. 33 32-39)
Females				
atricapilla (1)	55	11	15.2	34
malacca (3)	55, 59, 60 (IH 53-56	11.4, 11.6, 12.5 from skull 13-14	15.5, 16 (2) *c.* 16	31, 33, nil 31-36)
	1978a *Padda oryzivora*			
Male (1)	68 (IH m/f 66-69	15 from skull 17-18	19 18-19	42 46-47)

Furthermore, *fumigata* and *semistriata* are smaller.

Measurements on p. 351.

1968 ***Lonchura striata striata*** (Linnaeus) Isle of Bourbon, *errore* = Ceylon. White-rumped munia 3: 83

22: 11 males, 7 females, 4 unsexed.

2 Mahal, Surat Dangs, S. Gujarat, 1 Ratory, Malad, 2 Trombay Is., 1 Thana Hills, Salsette, 1 Panvel, 1 Valpoi, Goa, 1 Santgal, N. Kanara, 2 Mercara, Coorg, 1 Kumili High Range, Kerala, 1 Manalur, Palni Hills, 2 Chettiri Range, Salem district, 1 Sankrametta, 1 Dharakonda, Upper Sileru, Vizagapatom, 1 Badrama, Bamra, 1 Ranipathar, Phulbani district, Orissa, 1 Bhopalpatnam, 1 Barsur, Bastar district, MP, 1 No locality (cage bird).

The distinct streaks on the back, larger size and heavier bill separates this race from *semistriata* and *fumigata*.

Measurements on p. 351.

1969 ***Lonchura striata fumigata*** (Walden) (South Andamans). White-rumped munia 3:83

5: 2 males, 1 female, 2 unsexed.

2 Long Island, 1 Bakurtala, Middle Andaman, 1 Pochang, 1 South Andaman.

Appreciably larger in hand than *semistriata*. Streaks on upper parts very faint, also pale fringes of breast feathers very faint or absent.

Measurements on p. 351, 352.

1970 ***Lonchura striata semistriata*** (Hume) Nicobars. White-rumped munia 3: 84

10: 5 males, 4 females, 1 unsexed.

4 Camorta, Nicobar, 6 Car Nicobar.

All ten specimens were collected by the late Humayun Abdulali in 1966 and 1976. They are smaller than the birds of the other 3 races. Pale rufous fringes of the breast feathers form a scale-like pattern and streaks are clearly visible on the back.

Measurements on p. 351, 352.

1971, 1972 ***Lonchura kelaarti jerdoni*** (Hume) (Wynaad). Black-throated munia 3: 88

8: 3 males, 4 females, 1 unsexed.

1 Bombay market (No locality), 2 Bhatkar, Karwar, 1 Santanpara, Cardamom Hills, 2 Tenmala, 1 Travancore, 1 Sankrametta, Vizag.

Measurements on p. 352.

1973 ***Lonchura kelaarti kelaarti*** (Jerdon) (Ceylon). Black-throated munia 3: 89

nil.

1974. ***Lonchura punctulata punctulata*** (Linnaeus) (Asia = Calcutta). Spotted munia 3: 91

57: 29 males, 15 females, 13 unsexed.

2 Kulu, 1 Basantpur, Bhajji, 2 Simla, 1 Simla Hills, 1 Solan, Bhagat, 1 Kalka, 1 Kandaghat, Patiala, NW Himalayas, 1 Ranigarh, Naini Tal, 1 Bhuguwda, Nepal, 2 Dediapada, Rajpipla, Gujarat, 1 Bijwar, Indore, 1 Sonawani, Balaghat, 2 Raipur, Melghat, Berar, 1 Golapalli, 1 Bailadila, Bastar, 1 Daulatbad, Aurangabad, 2 Padgha, Thana Dt, 2 Manauri Is., 2 Kalyan, Thana, 2 Mud Island, 1 Santacruz, Salsette, 1 Jogeshwari caves, 3 Pali Hill, Bandra, 5 Andheri, 1 Panvel, 1 Khandala, 2 Ratnagiri, 1 Bhatkal, N. Kanara, 1 Nenmara, Cochin, 1 Kodaikanal, 2 Perumalmalai, Palni Hills, 1 Manalur, Palni Hills, 1 Kottagiri, Ooty, 1 Palkonda Hills, S. Cuddapda, 1 Koduru, Cuddapda district, AP, 2 Nilgiri, 4 Keonjhargarh, Orissa.

Measurements on p. 352.

1975 ***Lonchura punctulata subundulata*** (Godwin-Austen) (Manipur Valley). Spotted munia 3: 92

8: 3 males, 3 females, 2 unsexed.

3 Dibrugarh, 1 Sonarupa Sanctuary, 1 Darang, Ranikalta camp, Goalpara, Assam, 1 Chimakothi, W. Bhutan, *2 Kanaung, Henzada district, Burma*.

The key in the HANDBOOK (Vol. 10, p. 113) says that the nominate race distributed in the greater part of India has fulvous undertail coverts and thus can be separated from *subundulata* of NE with almost white undertail coverts. In the museum specimens, this difference is not observed and they were separated based on the localities. We have only eight specimens of

subundulata, three of them collected in 1901, one each in 1910, 1949, 1968 and two in 1930. Only 4 specimens are in adult plumage. With such a small sample, it is difficult to make any serious studies. However, these birds seem to be comparatively smaller than the nominate race.

The four specimens have brown scaling as mentioned by Grimmett *et. al* in BIRDS OF THE INDIAN SUBCONTINENT (1998), p. 829. But older specimens of the nominate race also have brown instead of black scaling.

Measurements on p. 352.

1976 ***Lonchura malacca rubroniger*** (Hodgson) (Nepal). Black-headed munia 3: 81

nil

1977 ***Lonchura malacca atricapilla*** (Vieillot). (Les Grandes - Indes', restricted to Lower Bengal by Robinson & Kloss). Black-headed munia 3: 81

6: 4 males, 1 female, 1 unsexed.

1 Sadiya, Upper Assam, 2 North Lakhimpur, 1 Lakhimpur, 1 Guilong, Nr. Cachar, *1 Maymyo, Burma.*

Measurements on p. 352.

1978 ***Lonchura malacca malacca*** (Linnaeus). ("China, Java and Malacca" *errore* = Belgaum, restricted by Baker 1926). Black-headed munia 3:78

20: 11 males, 4 females, 5 unsexed.

1 Thana, 2 Colaba, 3 Darmatar creek, Kolaba district, 1 Ratnagiri, 1 Karwar, 3 Belgaum, 1 N Kanara, 1 Thattakkadu, 1 Devikulam, 1 Karimulakkunnu, Travancore, 1 Periakulam, 2 Kodaikanal, TN, 1 South India, 1 No locality (Nellore AP?).

L.m. atricapilla with its chestnut upper belly and sides can easily be separated from the nominate race having the above mentioned parts white and also larger size.

Measurements on p. 352.

1978a ***Padda oryzivora*** (Linnaeus) (Java). Java sparrow

1 male, from Singapore.

Measurements on p. 352.

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TRANSLOCATION OF RHESUS MACAQUES FROM AIRFORCE STATION, GURGAON (HARYANA) TO THE NATURAL FOREST OF FIROZPUR- JHIRKA, HARYANA, INDIA[1]

Ekwal Imam[2], Iqbal Malik [3] and H.S.A. Yahya[2]

(*With two text-figures*)

Key words: Translocation, *Macaca mulatta*, monkey menace

The occurrence of monkeys in human habitations has created enormous problems in recent years in different parts of India. During the present study, a group of troublesome monkeys in the vicinity of Gurgaon Air Force Station (GAFS) were translocated on an experimental basis. Of the 28 monkeys counted during June 1998, in the GAFS area, 22 were caught and translocated successfully to the natural forest of Firozpur-Jhirka (Aravali Range, Haryana), where adequate food and shelter was available. The release area was revisited in March 2000 to ascertain the status of the released monkeys. It was heartening to see them well settled in their new habitat.

Introduction

Approximately 48.5% of the 0.3 million rhesus macaques of north India are living in human habitations (Southwick and Siddiqi 1994), resulting in conflict and competition for space and food between man and monkey. The troops invade settlements, often damaging human property. The harassed humans resort to hitting or shooting the monkeys. Consequently, monkey groups become more aggressive, and increasing number of monkey bites are reported.

Monkeys are an integral part of India's rich biodiversity. It is, therefore, our foremost duty to minimise the man-monkey conflict. Of all the non-destructive control measures, translocation is one of the most successful methods of rehabilitating a troublesome population to an area where it can resettle (Southwick *et al.* 1984, Forthman 1986, Strum and Southwick 1986, Else 1991, Imam 1991, Malik & Johnson 1991 & 1994, Siddiqi & Southwick 1993, and Imam & Malik 1997). Recently, Yahya and Imam (2001) translocated 18 monkeys from the Aligarh Muslim University campus in Aligarh. However, the world's largest translocation of 600 monkeys, to the forest patches of Mathura district, from Vrindaban (Mathura-UP, India) was carried out during 1997 (Imam *et al.* in press). These successful translocation programs motivated us to adopt the same technique to solve the GAFS monkey problem.

Trapping and Releasing sites

Gurgaon Air Force Station is situated 28 km south of New Delhi in Gurgaon, Haryana (28° 37' N, 77° 04' E). The campus includes a hospital, kitchen and mess, residences, offices, and plantations of some common trees such as *Eucalyptus* spp., *Acacia catechu*, *Albizzia lebbek*, *Azadirachta indica*, *Zizyphus mauritiana*, *Dalbergia sissoo*, *Ficus bengalensis*, *F. religiosa*, *Prosopis juliflora* and *Tamarindus indica*.

The release site, Firozpur-Jhirka, (27° 47' N, 76° 59' E), near the Jhir Mandir, has a pond and perennial *nullah* with a fairly good forest patch on either side of the *nullah*. *Acacia leucophloea*, *A. catechu*, *Anogeissus pendula*, *Ailanthus excelsa*, *Azadirachta indica*, *Zizyphus mauritiana*, *Balanites aegyptica*, *Butea monosperma*, *Casearia elliptica*, *Cassia fistula*, *Emblica officinalis*,

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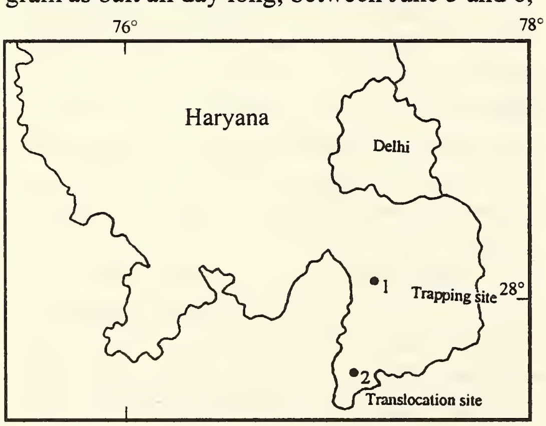
Dalbergia sissoo, *Ficus tomentosa*, *F. bengalensis*, *F. religiosa*, *Lannea coromandelica*, *Sterculia urens*, *Terminalia tomentosa*, *Prosopis juliflora*, *Tamarindus indica* and *Tectona grandis* were the common trees at the site.

METHODS

A preliminary survey was conducted from May 23-30, 1998 to estimate the population, activity sites and night shelters of the monkeys inside the GAFS premises. The monkeys were lured with food to facilitate counting.

The forest area of Firozpur-Jhirka (situated about 100 km south of Delhi in the Aravali range, Haryana) was surveyed to locate a suitable release site (Fig. 1). Availability of food, water, shelter, cultivation and proximity to human habitation were considered while selecting the sites for translocation. The monkeys were then trapped with the help of a portable iron trapping cage, of 2 m x 2 m x 2 m size with a heavy sliding door (Fig. 2), installed at night. The door was tied with a pulley, operated by a man hidden in a drum 20 m away, with an eye-hole to help him observe the monkeys coming inside the cage. The monkeys were trapped using banana and roasted gram as bait all day long, between June 3 and 6, 1998, at alternate sites. To avoid group fission, we tried trapping an entire group from one site on the same day. The trapped monkeys were then transferred into a holding cage 0.5 m x 0.5 m x 0.5 m in size, and finally into a releasing cage of 5 m x 2.5 m x 2.5 m, which were transported by a mini truck. All the cages were provided with food and water. The monkeys were released near trees at the translocation site early in the morning between 0200 and 0300 hrs.



1. Gurgaon Airforce Station; 2. Firozpur-Jhirka Patch

Fig. 1: Trapping and translocation sites of rhesus macaque *Macaca mulatta* in Haryana

RESULTS AND DISCUSSION

Out of 28 rhesus macaques, 22 were trapped. The first trapping was undertaken near the GAFS mess kitchen, where 3 adult males, 4 adult females and 5 immatures were trapped. The next day, 3 adult males, 4 adult females and 3 immatures were trapped from the tube-well building early in the morning. We were unable to trap any monkeys that evening, as they had become wary of us and left the area. The trapped monkeys were transported the same night and released near large, shady trees at the chosen site to avoid stress and mortality, which the hot summer days might have caused. Sufficient gram, vegetables, banana and other fruits were placed at the release sites, as an immediate supply of food. This practice was continued for a week to acclimatise them to the new area.

To ascertain if the monkey population had settled in the Firozpur-Jhirka forest, the area was revisited on March 17, 2000. Two groups of 12 and 8 were seen near the temple. Since this area had no resident rhesus macaques groups earlier, and no other monkeys had been released there earlier, it was assumed that the groups observed were the ones released in June 1998. The temple priest and local people also confirmed this assumption. The first author visited GAFS the next day, and found that except for 4 new infants no other monkeys had joined the population of the area.

The monkey menace seems to have started with the forced restriction of large populations

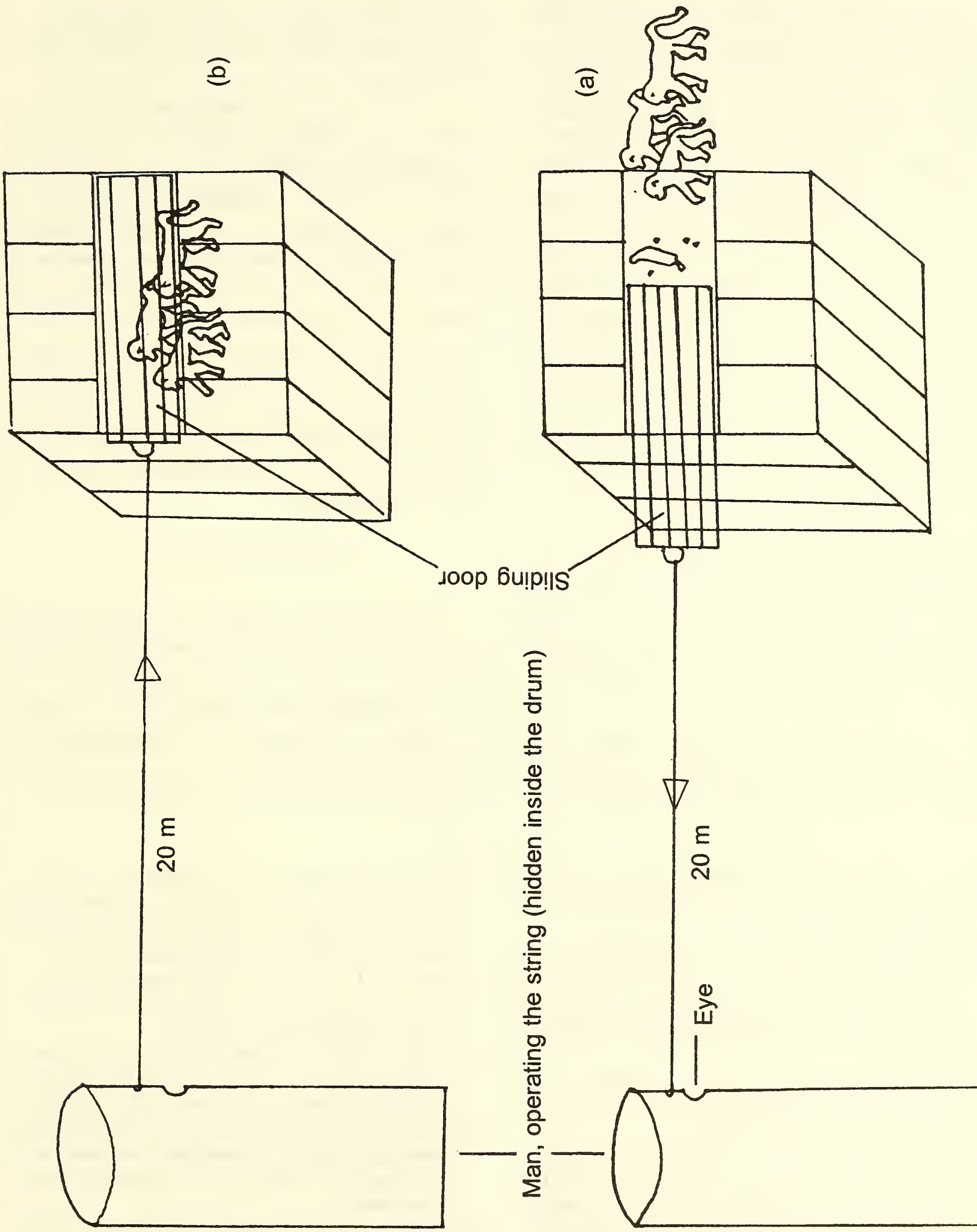


Fig. 2 : Trapping cage (a) baited with open door (b) trapped monkey

of rhesus macaques from their natural habitats to urban areas due to intensive urbanisation and expansion of agriculture. The 1978 ban on the export of primates from India and protection provided by the local people has also helped the population grow locally. In the absence of natural predators, in many places the monkey groups have increased beyond the carrying capacity of the area (Southwick and Siddiqi 1988). The GAFS had a similar problem, where the group was confined to a localised area and exposed to continuous contact with humans. Besides monkey bites and the unbearable nuisance, there may be a possible transmission of certain pathogens (e.g. *Shigella, Salmonella*) from monkey to man and *vice versa* (Shah and Southwick 1965, Tiwari and Shukla 1984).

The present translocation was a small attempt to reduce man-monkey conflict and rehabilitate the urban monkeys in their natural habitat. The post translocation visit to GAFS and Firozpur-Jhirka revealed that translocation of rhesus macaques was a successful attempt in this case.

During the last visit it was observed that translocation of monkeys has been a great relief to the residents and officials of GAFS. After a gap of 20 months, it was found that the translocated monkeys were doing well in their new locations.

The rhesus is not endangered in India, but is in a vulnerable position, as it is strongly commensal/semi-commensal and is capable of causing considerable damage to crops and other property, resulting in conflict with man. In India, 86% of the total rhesus macaque populations reside near human habitations (Southwick and Siddiqi 1994), and their conservation depends on a cordial relationship with man. The present study revealed that translocation of monkeys from GAFS has helped reduce this conflict. We believe that rhesus translocation has much to offer as it helps to design management plans for other primate species.

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*Original not seen.

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NOTES ON THE POLYGONACEAE OF SIKKIM[1]

S.S. DASH AND P. SINGH[2]

Key words: Polygonaceae, *Aconogonon, Persicaria,* Sikkim

The paper provides notes on species of *Aconogonon* and *Persicaria* in Sikkim. Two new combinations, one under *Aconogonon* and another under *Persicaria*, are proposed.

Aconogonon (Meisn.) Rchb.

The genus is mainly distributed in Asia and North America, and comprises of *c.* 15 species, of which 11 species occur in the Himalayan region. The first record of *Aconogonon* from Sikkim was made by Griffith who collected *A. molle* (D. Don) Hara (as *Polygonum molle* D. Don) and *A. rude* (as *Polygonum rude* Meisn.) in the early 19th century from somewhere in Sikkim and Bhutan. J.D. Hooker collected 4 species, namely *A. campanulatum* (Hook.f.) Hara, *A. molle* (D. Don) Hara, *A. hookeri* (Meisn.) Hara, and *A. polystachyum* (Meisn.) M. Kral (all under *Polygonum*) from different parts of Sikkim during his tour in the area between 1848-49. At present, 7 species have been recorded from Sikkim. Only *A. hookeri* (Meisn.) Hara is restricted to Sikkim, Bhutan and southeast Tibet, all other species are widely distributed in Himalayas. Their altitudinal preferences are from warm temperate to alpine regions of the state. *A. paniculatum* (Bl.) Haraldson sometimes grows as low as 1,300 m, and the most alpine species is *A. hookeri* (Meisn.) Hara, which is found up to 5,000 m.

With 7 out of 11 Himalayan species, Sikkim is relatively rich in *Aconogonon*. This makes an interesting comparison with 5 species and 5 varieties from Nepal (Hara 1982), 4 species from Himachal Pradesh (Chowdhery and Wadhwa 1984) and 5 species and 3 varieties from Bhutan (Grierson and Long 1983).

Study of the available material of *Aconogonon* at BSHC poses the problem of species delimitation. In recognizing species, we have followed Hara (1982) to a great extent. However, his placement of *Aconogonon polystachyum* (Meisn.) M. Kral under *Persicaria* is being contested here, due to the presence of characters like flowers in branching racemose panicles, campanulate and exserted from bracts, which favour its retention under *Aconogonon*. The treatment of *A. rude* (Meisn.) S.S. Dash & P. Singh as a distinct species is favoured by the characters mentioned in the following key and in Table 1.

KEY TO THE SPECIES OF *ACONOGONON*

1a. Plants dwarf, unbranched, only with radical leaves, cauline leaves absent or rarely 1-2 .... *Aconogonon hookeri*

b. Plants shrubby with much branched stem, radical leaves absent, cauline leaves present 2

2a. Perianth spreading, cleft nearly to the base 3

b. Perianth campanulate, cleft up to 2/3 down ... 6

3a. Flowers more than 4 mm across, panicles dichotomously branched, achenes without baccated perianth, enclosed in perianth .... *A. polystachyum*

b. Flowers less than 4 mm across, panicles thyrsiform, achenes with baccated perianth, slightly exserted from perianth 4

4a. Plants glabrous, leaves turn black when dry .... *A. paniculatum*

b. Plants pubescent or densely hairy, leaves not black when dry 5

5a. Plants strigose hairy, nodes with reflexed hairs, venation of perianth reticulate .... *A. rude*

b. Plants whitish villous, stem densely appressed hairy with silky white hairs, nodes without deflexed hairs, venation of perianth parallel .... *A. molle*

6a. Leaves ovate-elliptic, acute at apex, 1-3 x 0.8-1.5 cm, sessile or subsessile, inflorescence

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TABLE 1

COMPARATIVE MORPHOLOGY OF THE SPECIES OF *ACONOGONON* OF SIKKIM

A. molle (D. Don) Hara	*A. paniculatum* (Bl.) Haraldson	*A. rude* (Meisn.) S.S. Dash & P. Singh	*A. polystachyum* (Meisn.) M. Kral	*A. tortuosum* (D. Don) Hara	*A. campanulatum* (Hook.f.) Hara	*A. hookeri* (Meisn.) Hara
1. Undershrubs or shrubs.	Shrubs.	Shrubs.	Shrubs up to 150 cm high.	Shrubs, stems dichotomously branched.	Sub-erect stoloniferous herbs with ascending branches.	Dwarf perennial herbs with thick rootstock.
2. Stems striate, appressed densely pubescent or velutinous, nodes with ascending hairs.	Stems striate, glabrous.	Stems striate, glabrous or appressed pubescent, nodes with ring of deflexed hairs.	Stems glabrous or minutely pubescent, but without ring of deflexed hairs at nodes.	Older stems glabrous, younger stems very minutely finely pubescent, sulcate.	Stem minutely pubescent.	Stem silvery pubescent.
3. Leaves lanceolate, 6-12 x 1-3 cm, densely silky hairy beneath, lateral veins 20-30 pairs, petioles up to 1.5 cm long.	Leaves ovate to lanceolate, 4-12 x 1.5-5 cm glabrous on both side, turn black when dry, lateral veins 18-30 pairs, petioles 1-2.5 cm long.	Leaves ovate-lanceolate to lanceolate, up to 17 x 7 cm, appressed pubescent on mid-vein and lateral veins beneath, lateral veins 12-20 pairs, raised on ventral side, petioles up to 1.5 cm long.	Leaves ovate-elliptic, 7-20 x 1.5-8 cm, glabrous on upper surface, very smoothly pubescent on lower surface, lateral veins 12-20 pairs, sub-sessile or petioles up to 1 cm long.	Leaves ovate-elliptic, 1-3 x 0.8-1.5 cm, rounded at base, finely pubescent on both surface sessile or sub-sessile, lateral veins up to 8 pairs.	Leaves elliptic-ovate or lanceolate, 5-12 x 2-5 cm, usually grey tomentose beneath, lateral veins 10-23 pairs, petioles 1-1.5 cm long.	Leaves oblong-oblanceolate, 2.5-6 x 0.6-3 cm, sparsely white sericeous on both surfaces, lateral veins 8 pairs, mostly basal sub-sessile or sessile.
4. Ochrea *ca* 1 cm long, thick, cupshaped, truncate, densely velutinous.	Ochrea *ca* 1 cm long, membranous, younger are truncate, older split, glabrous.	Ochrea up to 2.5 cm long, membranous, minutely pubescent.	Ochrea up to 2.5 cm long, tubular membranous, glabrous.	Ochrea 0.7-1.5 cm long, tubular, but cleft at apex, pubescent.	Ochrea 0.7-1.5 cm long, tubular, sometimes truncate, minutely pubescent.	Ochrea 1 cm long, brownish, tubular, glabrous or minutely pubescent.
5. Inflorescence of thyrsiform racemes, rachis *ca* 13 cm long, densely appressed pubescent, bracts ochreolate, papery.	Inflorescence of lax thyrsiform racemes, rachis up to 14 cm long, glabrous, bracts ovate, acuminate at apex, papery.	Inflorescence of dense thyrsiform racemes, rachis up to 12 cm long, bracts ovate-lanceolate, glabrous.	Inflorescence of lax, dichotomously branched panicles, rachis up to 8 cm long, pubescent, bracts ovate.	Inflorescence of dense terminal panicles, rachis 1-4 cm long, pubescent, bracts ovate-lanceolate.	Inflorescence of axillary and terminal divaricately branched cymes, rachis up to 10 cm long, pubescent, bracts ovate.	Inflorescence of slender solitary branched racemose panicles, rachis 4-10 cm hirsute, bracts minute.

TABLE 1 (CONTD.)

COMPARATIVE MORPHOLOGY OF THE SPECIES OF *ACONOGONON* OF SIKKIM

A. molle (D. Don) Hara	*A. paniculatum* (Bl.) Haraldson	*A. rude* (Meisn.) S.S. Dash & P. Singh	*A. polystachyum* (Meisn.) M. Kral	*A. tortuosum* (D. Don) Hara	*A. campanulatum* (Hook.f.) Hara	*A. hookeri* (Meisn.) Hara
6. Flowers creamy, perianth 5, ovate-oblong, divided up to base, *ca* 3 mm long, parallel veined, stamens 8, ovary trigonous, turgid, styles 3.	Flowers white, perianth 5, ovate-oblong, 2 x 1 mm, divided up to base, parallel veined, stamens 8, arises from a basal disc, anthers basifixed.	Flowers brown, perianth 5, broadly ovate-oblong, 2 x 1 mm, reticulately veined, stamens 8, anthers basifixed, ovary trigonous.	Flowers creamy white, perianth 5, unequal, 2+3, outer obovate-oblong, inner obovate-spathulate, *ca* 4 x 4 mm, parallel veined, stamens 8, anthers dorsifixed, black, ovary trigonous.	Flowers white, perianth 5, obovate, 3.5 x 3 mm parallel veined, stamens 8, filament 1 mm, anthers dorsifixed, ovary trigonous.	Flowers pinkish or pinkish-white, perianth 5, oblong, *ca* 5 mm, parallel veined, stamens 8, anthers dorsifixed, ovary trigonous.	Flowers deep crimson, or deep brown with yellow tips, perianth 5, *ca* 2 mm across, parallel veined, stamens 8, imperfect in female flowers, ovary trigonous.
7. Achenes trigonous, always with baccated perianth, exserted from perianth on maturity	Achenes trigonous, with baccated perianth, exserted on maturity, turn black when ripe.	Achenes trigonous, exserted from perianth, with baccated perianth.	Achenes trigonous, brown, shorter than perianth, enclosed or exserted from perianth.	Achenes trigonous, brown, shining, not winged.	Achenes trigonous, pale yellow, slightly winged, exserted from perianth.	Achenes trigonous, exserted from perianth on maturity.

TABLE 2
COMPARATIVE MORPHOLOGICAL CHARACTERS OF *PERSICARIA BIRMANICA* AND *P. PRAETERMISSA*

Persicaria birmanica (Gage) S.S. Dash & P. Singh	*Persicaria praetermissa* (Hook.f.) Hara
1. Stems spineless, glabrous or minutely pubescent.	1. Stems with regular rows of hooked spines.
2. Leaves deltoid, 3-6 x 1-3 cm, hastate at base, hastate lobes do not come down to petiole.	2. Leaves linear, 3-8 x 0.7-1.5 cm, hastate at base, hastate lobes come down to petiole.
3. Ochrea glabrous.	3. Ochrea hairy.
4. Inflorescence rachis glabrous.	4. Inflorescence rachis glandular-hairy.
5. Perianth segments 5.	5. Perianth segments 4.
6. Stamens 8.	6. Stamens 5.
7. Ovary trigonous, styles 3.	7. Ovary biconvex, globose, styles 2, branched.

terminal, 1-4 cm long, perianth 1.5-3 mm across, achenes not winged .... *A. tortuosum*

b. Leaves ovate-lanceolate, acuminate at apex, 5-12 x 2-5 cm, distinctly petiolate, inflorescence axillary and terminal, 4-10 cm long, perianth 4-5 mm across, achenes slightly winged 7

7a. Leaves fulvous tomentose beneath .... *A. campanulatum* var. *campanulatum*

b. Leaves pubescent beneath .... *A. campanulatum* var. *oblongum*

The taxonomic decision of keeping *A. rude* as a distinct species necessitates the proposal of a new combination as follows:

Aconogonon rude (Meisn.) S.S. Dash & P. Singh comb. nov.

Polygonum rude Meisn. in DC. Prodr. 14(1): 137.1856; Hook.f. Fl. Brit. India 5:49.1886. *Aconogonon molle* (D.Don) Hara var. *rude* (Meisn.) Hara in Fl. E. Him. 68. 1966 (as *Aconogonum*).

Distribution: INDIA: Assam, Sikkim. Nepal, Bhutan, Myanmar, Indo-China, north China.

Persicaria Mill.

Gage (1903) described *Polygonum birmanicum* Gage based on collection from Myanmar (Burma). Cave in 1915 collected it from Namchi (Sikkim). Stewart (1930) while dealing with Polygonaceae (as Polygoneae) of eastern Asia considered *Polygonum praetermissum* Hook.f. as a variable species and merged *Polygonum birmanicum* Gage under it. However, these two species come within the circumscription of the genus *Persicaria* and can be separated on the basis of the characters shown in Table 2.

It is clear from Table 2 that *Polygonum birmanicum* Gage needs to be given specific status under the genus *Persicaria*. A new combination is proposed here:

Persicaria birmanica (Gage) S.S. Dash & P. Singh comb. nov.

Polygonum birmanicum Gage in Rec. Bot. Surv. India 2: 412. 1903.

Distribution: INDIA: Sikkim. Myanmar

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SCANNING ELECTRON MICROSCOPIC STUDIES ON THE CONTACT CHEMORECEPTORS ON THE PALP-TIP OF *ORYCTES RHINOCEROS* L. (COLEOPTERA: SCARABAEIDAE)[1]

A. Mini[2]

(*With two plates*)

Key words: *Oryctes rhinoceros* L., palp-tip sensilla, contact chemoreceptors, blunt-tipped pegs, pointed-tipped pegs, ball-in-socket type pegs, cuticular structures, digitiform sensilla

The terminal segment of the maxillary and labial palpi of *Oryctes rhinoceros* L. has an apical cluster of peg-like sensilla, which bear three morphologically distinct types of pegs, which are described and discussed. Morphology of the digitiform sensillar field, occupying a proximal position on the terminal palpal segment laterally, is also described. The studies concerning the functional modalities of the sensilla are based on the interpretation of structural data obtained via Scanning Electron Microscope analysis.

Introduction

Studies conducted by the author reveal that the extirpation of the extreme apex of the terminal palpal segments of *Oryctes rhinoceros* L. males renders them incapable of releasing courtship and copulatory behaviour upon contacting the female, whereas contact activation of sexual behaviour was found to be the rule in normal males. Deliberate exploration of the female's body surface employing the palpal tips was found to be a consistent component of the courtship behavioural sequence of the male. Scanning Electron Microscope (SEM) observations of the palpal tips revealed the presence of an apical cluster of peg-like sensilla, surrounded by numerous variously modified cuticular structures and at least some of these palp-tip sensilla are associated with the perception of a certain sexually activating stimulus. The studies also indicate the activating stimulus to be of the nature of a female contact sex pheromone (data to be published). Palpal sensilla, functioning as contact chemoreceptors, have been identified in a number of insect species (Frings and Frings 1949, Haskell and Mordue 1969, Haskell and Schoonhoven 1969, Klein and Muller 1978, Altner and Prillinger 1980). There are also numerous reports on palpal contact chemoreceptors playing a significant role in feeding behaviour (Blaney and Chapman 1970, Bernays *et al.* 1972, Blaney *et al.* 1973, Mitchell and Schoonhoven 1974), and some reports on their role in host-seeking behaviour (McIver and Charlton 1970). However, though the male palpi making deliberate contacts with the female's body during close-range sexual interactions have been reported in a number of beetles (Selander 1964, Mathieu 1969, Barak and Burkholder 1977), the functional significance of palpal involvement in sexual behaviour is not yet adequately established. Sex recognition via chemosensory filtration through the palpi has been suggested in some blister beetles (Mathieu, 1969). Perception of certain female pheromones via the palpi, facilitating copulation, was speculated for *Attagenus megatoma* Casey (Barak and Burkholder 1977).

The present study is an attempt to infer the probable functions of the palp-tip sensilla of *O. rhinoceros* L. by interpreting the structural data obtained via SEM analysis. The primary

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objective is to corroborate the inference that at least a few of the sensilla on the palpal tips are capable of perceiving a contact chemoreceptive stimulus. This is the first report of its kind on *O. rhinoceros* L., and also provides a morphological base for further electrophysiological studies.

Material and Methods

The maxillary and labial palpi of 35-day-old male and female adults of *O. rhinoceros* L. were analysed, and photomicrographs taken, under a SEM.

Results

The apical cluster of peg-like sensilla on the terminal segment of the maxillary and labial palpi of the male and the female (Plate 1, Figs 1-4) revealed three morphologically different types of sensilla. Of these, the blunt-tipped pegs revealing an apical pore surrounded by movable cuticular processes, and the pointed-tipped pegs disclosing an apical pore on the tip of an eversible papilla, are similar to some of the contact chemoreceptors reported in other insects, while the ball-in-socket type pegs, far less numerous than the other types, are mechanoreceptors, and exhibited prominent sexual dimorphism in arrangement. The peg cluster is surrounded by four basic types of cuticular structures – (1) Open pores of varying sizes representing openings of cuticular glands and/or some cuticle sensillum. Pores bearing (2) a ball-like structure or (3) a dome-shaped spine or (4) a sickle-shaped body. The latter three types are probably mechanoreceptors. Though the shape of the same type of sensilla appeared different under different angles of observation, their apical features provided fairly reliable and easily detectable diagnostic criteria (Plate 1, Fig. 2; Plate 2, Fig. 5). The sensillar types thus recognised were:

1. Ball-in-socket type pegs (BSP) were the most conspicuous and least frequent sensilla, occupying the periphery of the cluster. In the male palpi, they showed a noticeable tendency to congregate towards the upper half of the cluster, which was more obvious in their maxillary palpi (Plate 1, Fig. 1), perhaps due to a greater number of sensilla than in the labial palpi (Plate 1, Fig. 3). In the females, however, the BSP encroached the lower half as well, to varying extents (Plate 1, Fig. 2, 4). Apical phase of the BSP disclosed a cavity bearing a ball-like structure at its centre, presenting a characteristic ball-in-socket appearance (Plate 2, Fig. 7, 8). Between this ball and the rim of the sensillum was a deep groove, of variable width, completely obliterated in some (Plate 1, Fig. 2), whereas others revealed a wide-open groove (Plate 1, Fig. 4). Certain fibre-like processes traversing this groove, between the ball and the rim, were observed in some BSP sensilla (Plate 2, Fig. 7, 8). The number of such connections per sensillum varied from one to four. A small slit splitting the apical rim into a discontinuous ring and forming a dimple-like depression on the side-wall, just below the apex, was another common characteristic (Plate 2, Fig. 7, 8).

(2) Blunt-tipped cylindrical pegs (BTP) had an apical diameter of about 3.13 µm (Plate 2, Fig. 10, 11). A magnification of 10,000x disclosed a slit-like apical pore bordered by a few lobe-like structures in some (Plate 2, Fig. 10) while numerous finger-like processes, apparently closing over an apical pore, were visible in others (Plate 2, Fig. 11).

(3) Pointed-tipped conical pegs (PTP) had an apical diameter of about 0.98 µm. At 10,000x, some of the PTP revealed a simple terminal pore at the tip of an apical papilla. This papilla exhibited a variable morphology ranging from a small protuberance (Plate 2, Fig. 12) to a larger funnel-shaped membranous pouch (Plate 2, Fig. 13). No such papilla was, however, visible in the remaining PTP under the same magnification

(Plate 2, Fig. 16), but a higher magnification of 15,000x revealed a large slit-like aperture at the tip of these 'non-papillate' sensilla (Plate 2, Fig. 17).

The sensilla were arranged in a cluster, with more or less uniform spacing, and the entire cluster was sometimes found as being depressed into the palp-tip (Plate 1, Fig. 2), while it remained everted in others (Plate 1, Fig. 1). The rather circular, and obviously retractile cuticle bearing the cluster revealed an irregular papillate texture, different from the smooth cuticle immediately surrounding it (Plate 1, Fig. 2), and the cuticular surface beyond this smooth area was rough with scaly protuberances (Plate 1, Fig. 3).

The smooth cuticle surrounding the peg-cluster revealed four types of cuticular structures, which were of consistent occurrence, but of inconsistent distribution pattern (Plate 1, Fig. 3). They were (1) Open pores (PO) of varying size, ranging from punctiform pores hardly visible at 600x to those of about 4.2 μm diameter (Plate 2, Fig. 14). (2) Pores bearing a ball-like body at their centre (PB) (Plate 2, Fig. 15). Fibre-like connections extending between this ball and the rim of the pore were observed in some (Plate 1, Fig. 4). (3) Pores bearing sharp-tipped, dome-shaped, spine-like structure (PD) (Plate 1, Fig. 3; Plate 2, Fig. 18). (4) Pores bearing sickle-shaped bodies with pointed or irregular-shaped tip (PS) (Plate1, Fig. 3; Plate 2, Fig. 19).

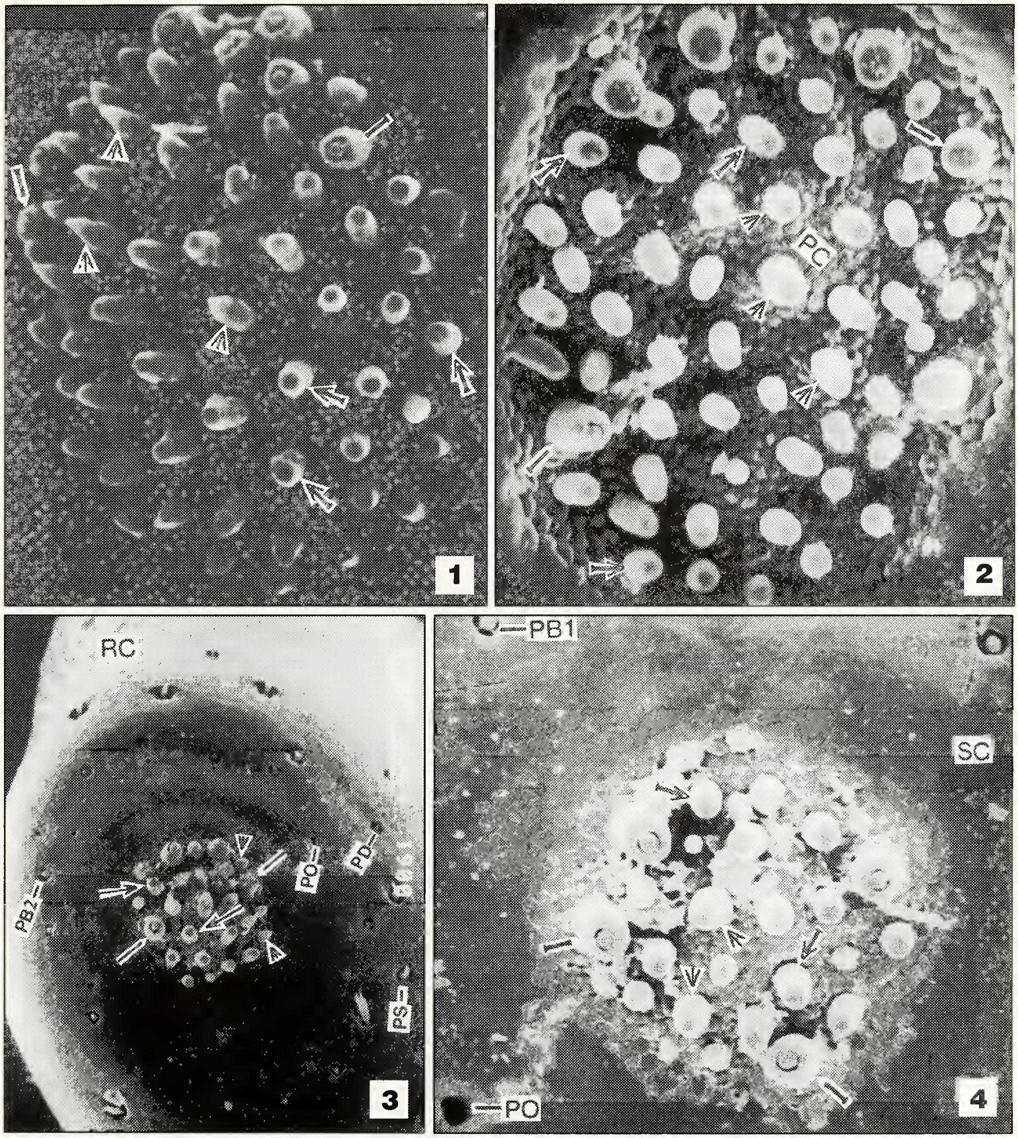
Apart from the apical cluster and surrounding cuticular structures, the terminal palpal segments revealed another prominent sensillar zone, slightly concave and rather oblong, situated latero-dorsally towards its base. It consisted of a dense array of finger-shaped (digitiform) sensilla, each positioned within a correspondingly shaped mesh formed by the surface cuticle (Plate 2, Fig. 6). The proximal end of the mesh was generally slightly tapering, compared to the rather blunt distal end. At 5,000x the sensilla disclosed at their distal end a minute, subapical protuberance (Plate 2, Fig. 9). The meshy surface cuticle further disclosed a few scattered pores, some of them displaying tubular extrusions, sometimes in the form of tortuous tubes, as being extruded out of, or lying in close association with them (Plate 2, Fig. 6).

Discussion

In external morphology, the BSP sensilla are similar to the "mechanosensory nipples" of *Ips typographus* L. (Hallberg 1982) as well as the mechanosensory "Ball-in-tee" companiform sensilla (Zacharuk 1985). Accordingly, the ball-like structure is the distal end of a central peg positioned within the outer cuticular socket, the former containing within it the sensory element called the tubular body. The above authors do not mention the fibre-like connections radiating between the ball and the socket apically in some of the BSP. Though the number of these connections was found to vary, the presence of four with a more or less symmetrical positioning (Plate 2, Fig. 7) seems to be typical. Whether the absence of such connections in some BSP is due to loss by accident, or reflective of a difference in the physiological state of the sensillum is not clear. That the apical groove of the BSP can remain open or closed to varying extents indicates that these connecting processes are flexible. This suggests their function in the opening and closing of this groove and/or in deflecting the central peg, the latter ability being regarded as a general requisite for mechanoreceptor sensilla (Zacharuk *et al.* 1977, Honomichl and Guse 1981). Like the mechanosensory nipples of *I. typographus* L., the BSP also occupy a peripheral position in the terminal cluster. By correlation of structure and function, a mechanosensory function can be attributed safely to the BSP sensilla.

The significance of sexually dimorphic pattern of distribution of the BSP is uncertain, though it suggests a sex-related difference in their

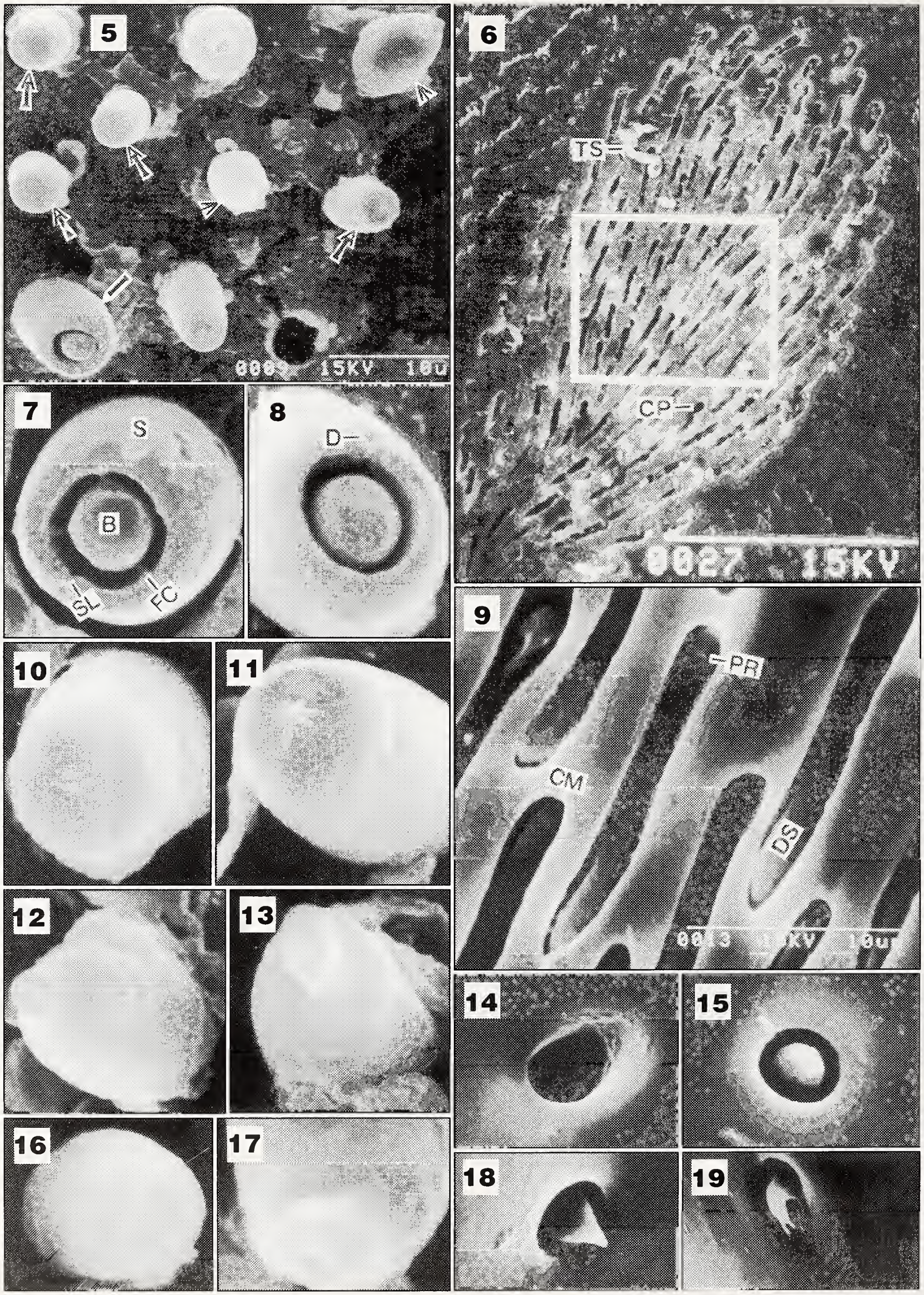
Mini, A.: *Oryctes rhinoceros* L. PLATE 1



Figs 1-4: Scanning Electron micrographs of the Palp-tip sensilla of *O. rhinoceros.* The arrows indicate BTP (Blunt-tipped peg), arrow-heads the PTP (Pointed-tipped peg) and the arrow-tails, the BSP (Ball-in-socket peg). 1. Maxillary palp-tip cluster of the male – everted condition (1000x); 2. Maxillary palp-tip cluster of the female – retracted state (1000x); 3. Labial palp-tip cluster of the male with surrounding cuticular structures (600x); 4. Labial palp-tip cluster of the female with a few cuticular structures (1000x).

PB1 – Pore with ball showing fibre-like processes; PB2-Pore with ball showing no fibre-like process, PC-Papillate cuticle; PD-Pore with dome-shaped spine, PO-Open pore, PS-Pore with sickle-shaped body, RC-Rough cuticle.

Mini, A.: *Oryctes rhinoceros* L. PLATE 2



For caption of Plate 2 see page 369

Plate 2: Figs 5-19: Scanning Electron Micrographs of different sensilla and cuticular structures on the terminal palpal segment of *O. rhinoceros*; 5. Part of a maxillary palp-tip sensillar cluster showing the BTP, PTP and BSP, indicated as in Fig. 1; the large pit represents a shed sensillum (3000x); 6. Digitiform sensillar field of a maxillary palp (600x); 7. BSP showing fibre-like connections (8000x); 8. BSP having no fibre-like connections (8000x); 9. A few digitiform sensilla (5000x); 10. BTP showing lobe-like structures around the apical pore (10,000x); 11. BTP showing finger-like processes presumably closing over the apical pore (10,000x); 12. PTP showing apical papilla as small protuberance bearing the apical pore (10,000x); 13. PTP showing fully everted funnel-shaped apical papilla bearing the apical pore (10,000x); 14. Open Pore (5000x); 15. Pore with ball (5000x); 16. PTP showing no apical papilla (10,000x); 17. "Non-papillate" PTP showing a large aperture apically (15,000x); 18. Pore with dome-shaped spine (5000x); 19. Pore with sickle-shaped body (2000x).

B-Ball, CM-Cuticular mesh, CP-Cuticular pore, D-Depression, DS-Digitiform sensillum; FC-Fibre-like connections; PR-Protuberance; S-Socket; SL-Slit; TS-Tortuous secretion.

function. Perhaps a greater density of these sensilla towards the 'upper' part of the apical phase, as found in the male, may be serving to provide a more intense sensory input during palpation. The significance of the individual variation observed with respect to the number of BSP on the maxillary palpi (6-8) against a fixed number of them in the labial palpi (4) is not known. In *I. typographus* L. the maxillary and labial palpi possess an equal number (2) of mechanosensory nipples (Hallberg 1982).

According to the classification of Snodgrass (1935), the BTP as well as the PTP sensilla are basiconic. As per the typology of Altner (1977), they appear to be uniporous, both revealing an apical pore under the SEM. Presence of a single pore at the tip is a common characteristic of contact chemoreceptive sensilla (Altner 1977, Altner and Prillinger 1980, Zacharuk 1980, 1985). The BTP sensilla with cuticular modifications surrounding the apical pore seem to be uniporous sculptured sensilla (UPS) as described by Zacharuk (1980), and resemble in this respect the electrophysiologically established contact chemoreceptive peg-like sensilla on the palp-tip of Colorado potato beetle larvae (*Leptinotarsa decemlineata* Say) possessing 'villi-like structures' presumably surrounding the sensillar entrance (Mitchell and Schoonhoven 1974) and the contact chemoreceptive uniporous peg sensilla in the antennae of *Tenebrio molitor* L. larvae, which sometimes revealed 'finger-like projections' surrounding the pore (Bloom *et al.* 1982a). That the cuticular processes of BTP were found to converge apically in some (Plate 2, Fig. 11) while moved apart, appearing as lobes in some others (Plate 2, Fig. 10) suggests that they can open and close. Zacharuk (1980) has pointed out a similar condition in the villi-like processes of the taste receptors of *L. decemlineata* Say (Mitchell and Schoonhoven 1974).

The apical 'molting pore' of aporous sensilla can often be mistaken as the apical pore of uniporous sensilla under the SEM (Zacharuk 1985). Molting pore is the opening through which the dendritic sheath was shed during the previous molt, and is non-permeable (Zacharuk *et al.* 1977, Bloom *et al.* 1982b). Whereas some of the uniporous sensilla showed certain apical sculpturing around the pore, no such modifications are reported in non-permeable molting pores (Zacharuk 1985). The apical molting pore of the blunt-tipped peg sensilla in the antennae of *T. molitor* L. larvae (Bloom *et al.* 1982b) does not show any cuticular modifications, contrary to the apical pore of their uniporous peg sensilla (Bloom *et al.* 1982a). The available data, thus, suggests that the presence of cuticular modifications is implicative of a permeable pore, while their absence may indicate either a permeable pore or a molting pore. Thus, the apical pore of BTP sensilla is most probably a permeable pore, though Transmission Electron

Microscopic studies on its internal ultrastructure are necessary to conclude upon this point.

Terminal papilla as observed in the PTP sensilla of *O. rhinoceros* during the present study are also reported on the basiconic pegs of *Tettigonia viridissima* L. (Henning 1974) and some contact chemoreceptive sensilla of *Apis mellifera* L. (Whitehead and Larsen 1976). In the latter, same kind of sensilla are tipped with either a pore or a papilla, and the papilla is thought to represent either some exudate formed at the tip as reported by Dethier (1972) on the labellar contact chemoreceptor hairs of *Phormia regina* Meigen, or some eversible membrane-like structure. In the present study, the apical papilla of PTP sensilla exhibited an obviously eversible character, as could be evidenced from a series of micrographs depicting different stages of its eversion. The large slit-like aperture seen at the tip of the 'non-papillate' PTP sensilla is seemingly the result of the tucking-in or retraction of the apical papilla. A possible mechanism for the opening and closing of the apical pore is thus envisaged. The terminal pore of the chemoreceptor sensilla on the maxillary palp of *Locusta migratoria* L. is capable of being closed and opened in response to feeding (Bernays *et al.* 1972).

Of the cuticular structures surrounding the peg cluster, the pores bearing ball-like structure (PB) are similar to the 'mechanosensory cuticle sensilla' present on the palpal tips of *I. typographus* L. (Hallberg 1982). As in the BSP, fibre-like connections could be observed radiating between the ball and the rim in some, but not all, of these PB. The striking resemblance between the BSP and the PB in apical morphology is not surprising, in view of a common mechanosensitive function. The pores bearing dome-shaped spine (PD) and those bearing sickle-shaped irregular body (PS) disclosed no visible pores under the SEM. They are most probably mechanoreceptive like the majority of aporous sensilla (Zacharuk 1985). Functional identity of the open pores (PO), however, is quite uncertain at present. There are three possibilities regarding this: (a) They may be representing certain 'cuticle sensilla' characterised by the absence of any outer cuticular structures, like the single-pore contact chemoreceptors on the maxillary palp-tip of *Agrion puella* and *Ischnura elegans* (Bassemir and Hansen 1980), or the canal sensilla on the tarsal pulvillus of *Schistocerca gregaria* Forskal (White and Chapman 1990). (b) They may be the openings of cuticular glands, perhaps of different types depending on the difference in pore size. Barbier *et al.* (1992) reports similar openings on the terminal segment of maxillary palpi in *Semiadalia undecimnotata* Schn., where the larger openings found among the gustatory receptors on the distal surface are of ductless glands, while the small openings on its lateral sides are of glands with ducts. Such openings are also present over the entire body and appendages of adult males and females. In *O. rhinoceros* L. also the PO like structures are of wider distribution, as could be detected on the cephalic capsule, prothorax, pygidium and elytra of both sexes (author's unpublished data). (c) Some of the PO may be representing cuticle sensilla, and others, the gland openings.

Digitiform sensillar fields comparable to those in *O. rhinoceros* L. are present in a corresponding position in adult *Dermestes maculatus* De Geer (Honomichl and Guse 1981), *I. typographus* L. (Hallberg 1982) and *Ctenicera destructor* Brown (Zacharuk *et al.* 1977). In *T. molitor* L., adult digitiform sensilla are distributed in a scattered fashion (Honomichl and Guse 1981). In *O. rhinoceros* L., digitiform sensillar field occur on both the maxillary and labial palpi, as also in *Dendroctonus ponderosae* Hopkins (Whitehead 1981) but in *I. typographus* L. they are lacking in the labial palpi (Hallberg 1982).

The cuticular pores scattered over the digitiform sensillar field of *O. rhinoceros* L.

apparently correspond to the dermal gland openings occuring in association with the digitiform sensilla of *Dermestes* (Honomichl and Guse 1981). Presence of associated tubular extrusions appropriating with the pore diameter provides solid evidence for the glandular function of these pores in *O. rhinoceros* L. In *S. undecimnotata* Schn. also, a similar tortuous cylinder escaping out of the labellar gland opening was visualised under the SEM (Barbier *et al.* 1992). Digitiform sensilla of *C. destructor* Brown reveal a molting pore near their tip at 12,000x magnification (Zacharuk *et al.* 1977). The sub-apical protuberance appearing invariably in all the observed digitiform sensilla of *O. rhinoceros* L. at 5,000x might be representing a molting pore.

In spite of superficial homologies, there can be considerable difference in internal ultrastructure between the digitiform sensilla of different species, e.g., between those of *Dermestes maculatus* De Geer (Honomichl and Guse 1981) and *C. destructor* Brown (Zacharukk *et al.* 1977), which were considered as thermoreceptors and mechanorceptors respectively. The present data is not sufficient to derive the function of the sensilla in *Oryctes rhinoceros* L.

The present studies provide morphological evidence for the presence of two types of contact chemoreceptors, comprising a major portion of the palp-tip cluster, of which at least one is presumably associated with the perception of aphrodisiac contact sex pheromone. Further TEM as well as electro-physiological studies may serve to confirm the present findings.

Acknowledgements

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MIST-NET CAPTURE AND FIELD OBSERVATIONS ON THE SHORT-NOSED FRUIT BAT (CHIROPTERA: PTEROPODIDAE) *CYNOPTERUS SPHINX* (VAHL.)[1]

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(*With three text-figures*)

Key words: *Cynopterus sphinx*, mist-netting, foraging pattern, reproductive cycle, body mass

The present paper addresses the abundance, composition, reproductive status and body mass of adult males and females of the Indian short-nosed fruit bat *Cynopterus sphinx* captured by mist-netting. Both sexes exhibit peak foraging activity once before midnight, followed by another small foraging bout before dawn. Reproductive activity occurred twice in a year and the body mass cycle of females showed a predominantly bimodal pattern.

Introduction

In an animal population, the location, numbers, density, age and sex composition alter at different times of the year because of differential death rates, and other factors such as migration. This variation also depends on interaction with other factors such as food availability, predator pressure, inter- and intraspecific competition.

Alcock (1989) reported that mark and recapture studies are useful, in mobile animals, to study behaviour such as dispersal, migration, and foraging patterns. Chiropterans (both micro- and mega-) can be captured with mist-nets while they forage (Gaisler 1973, Heidman and Heany 1989). Mark and recapture studies were done by Fleming (1988), and by Kunz and Brock (1975) to observe activity patterns and social behaviour. Cosson (1995) reported megachiropteran flight activity level under forest canopy in South Cameroon by mist-net studies.

In the present study, the abundance, composition, reproductive status, foraging activity and body mass of adult male and female Indian short-nosed fruit bat *Cynopterus sphinx* were assessed, in relation with habitat and seasons through mist-netting.

Methods

The study was carried out from October 1995 to September 1997 in South India (8° 44' S, 77° 42' E). Nylon mist-nets of 9 m x 2.6 m with a mesh size of 38 mm were used to capture the bats from dusk to dawn, for 76 nights, at 23 different roosting and feeding areas (Avinet-dryden NY 13053 - 1103, USA). The mist-nets were placed away from illuminated areas so that the bats could not see them. The nets were set up as recommended by Kunz and Brock (1975) at 4 m above ground level. They were tied about half an hour before sunset and removed at 0600 hrs. The bats, which were trapped in the mist-net were removed immediately with gloved hands and placed in cloth bags, measured and released.

Whenever a large number of bats were captured within a short duration, they were placed in a holding cage with fruit to calm them down. Forearm length (using 150 mm vernier calipers) and body mass (using 100 g Salter

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spring balance), were measured. Also, the sex and reproductive condition (testes size in males, palpation in females) were determined. The captured bats were marked with a necklace (Balasingh *et al.* 1992) with ten different coloured beads representing numbers 0 to 9. The necklace was secured around the bat's neck, by crimping it with a copper ring, with long-nose pliers.

Recaptures were made periodically by repeated mist netting at different times over the season at the same study site. By comparing the data collected while marking with that of the recapture, the differences in their reproductive condition, forearm length and body mass could be analysed.

Results

A total of 1,393 bats were captured, of which 1,289 were *Cynopterus sphinx*. The captured bats were categorized as adult females, adult males, and juveniles. Peak foraging activity occurred during 2200 to 2300 hrs, followed by another small foraging bout during 2400 to 0500 hrs (Fig. 1). The year-round mist-netting programme revealed that *C. sphinx* emerges at 1815 hours at dusk and returns to day roost at 0515 hours.

No significant difference in body mass was observed in male bats, but two predominant peaks were obtained in females, one in March and another in July. This increase in body weight can be attributed to pregnancy (Fig. 2a, b). Male and female body weight over the seasons is significantly different (df=1,22; F=8.88; P=0.007).

There are two peak reproductive periods in a year, in March and in July. During these months, most of the captured females were pregnant and lactating, while the captured males had prominent testes (Fig. 3). During the study period, the recapture rate was 2.71% and in all

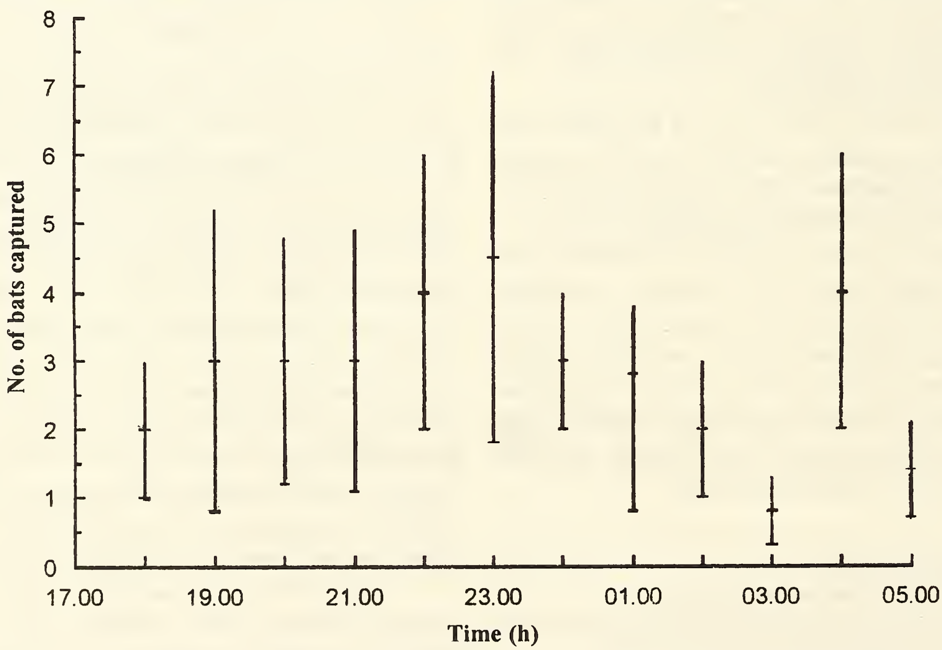

Fig. 1: Foraging pattern of *Cynopterus sphinx.* (The number of bats captured during every hour is the X ±SD of cumulative values of number of bats captured in hourly durations throughout the year)

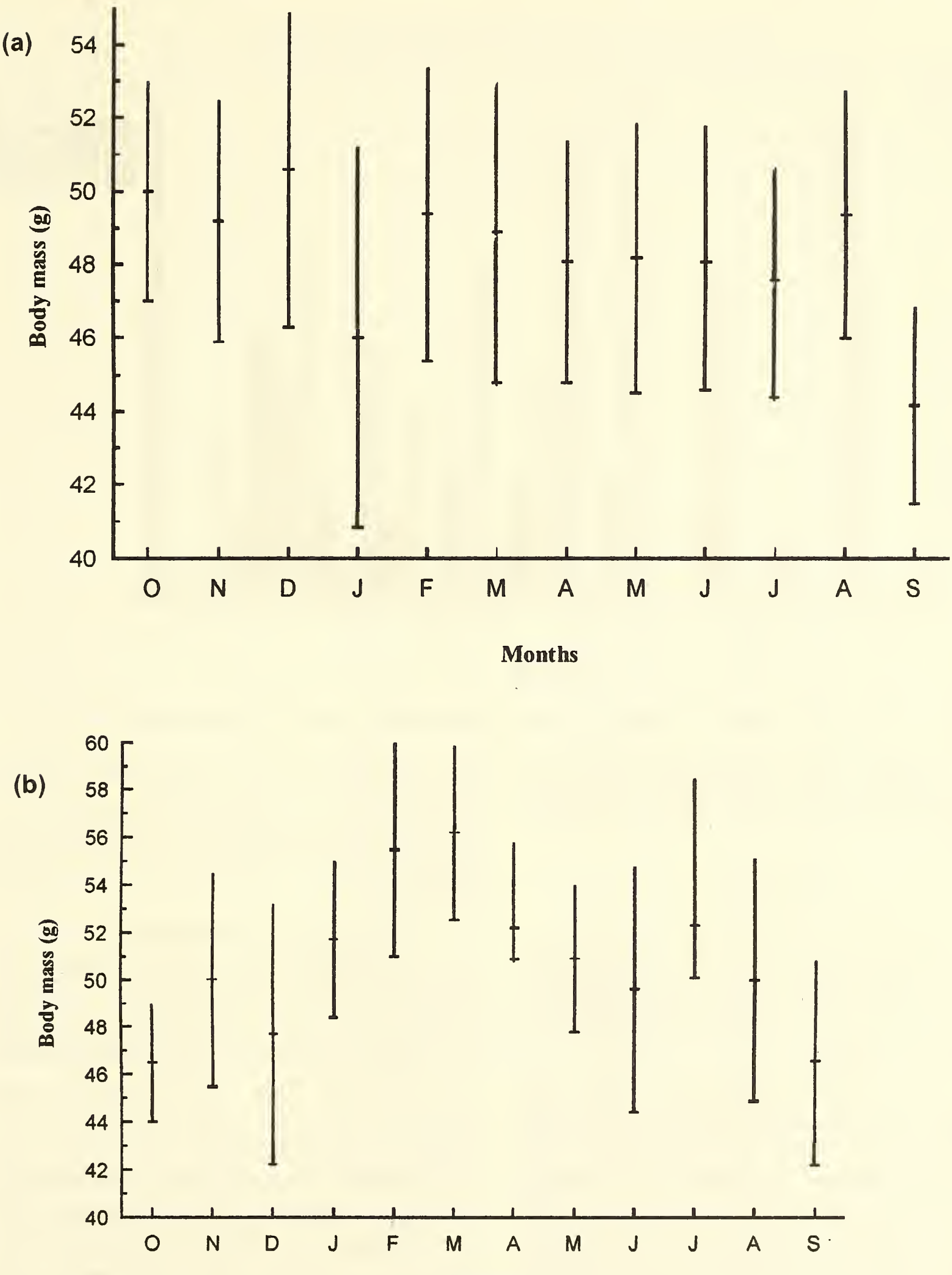

Fig. 2: Seasonal changes in the body mass of *Cynopterus sphinx* a) Male, b) Female

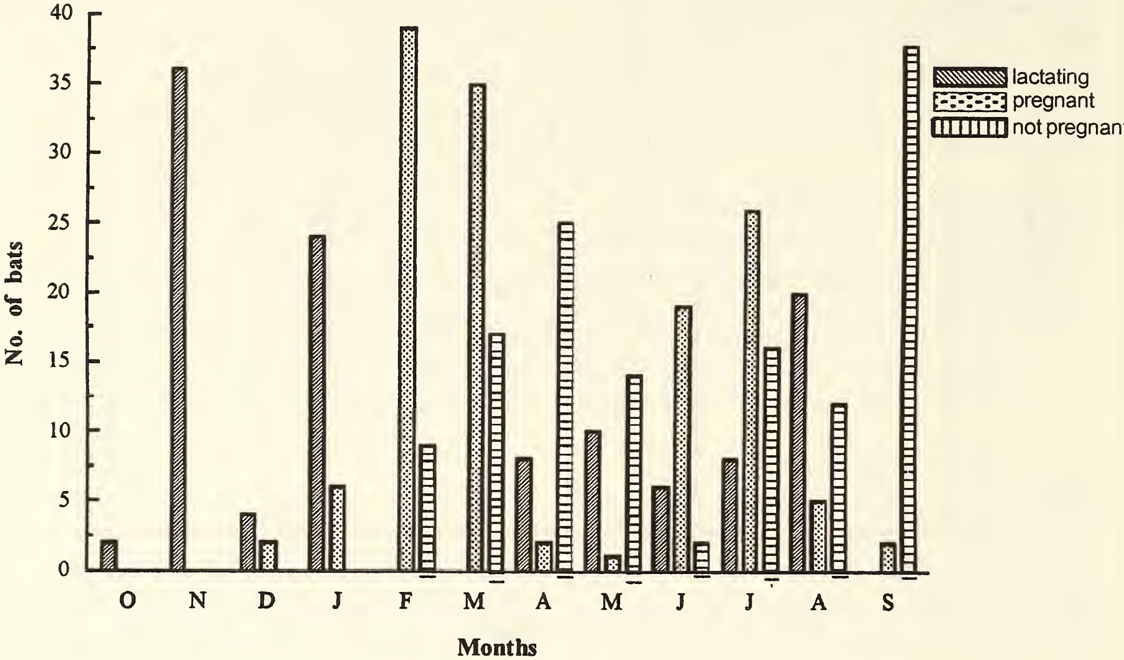

Fig. 3: Reproductive status of *Cynopterus sphinx* during different months compiled values for 2 years

the recaptured bats (21 bats) the necklace was intact. Both male and female bats were recaptured (Table 1).

Discussion

The year round captures of bats, banding and recapture data shows the distribution, foraging time and reproductive periods of *Cynopterus sphinx*.

Most of the mist-netted bats were *C. sphinx*, indicating that this species flies 2 to 4 m above ground level. The body weight of both the sexes changes seasonally. The foraging pattern was observed indirectly from the rate of mist-net capture at every hour from dusk to dawn. Peak captures were observed between 2200 to 2300 hrs, suggesting a predominant foraging activity period. The second, smaller peak at 0400-0500 hrs, may be return flights from the foraging area. Bimodal activity patterns are generally characteristic of insectivorous species. By contrast, unimodal patterns are dominant among frugivorous and nectarivorous species (Fleming 1982).

The maximum and minimum number of *C. sphinx* captured in a single night occurred in September and October respectively, even though fruiting was scarce in this period in our study area. There were only a few large *Polyalthia* trees with plenty of fruit, which attracted a large number of *C. sphinx* in and around Site I. The large number of *C. sphinx* netted from Site I indicates that fruit bats are easily attracted to any rarely occurring fruit during lean periods. The lowest capture normally occurred in places where there was no fruit. A detailed study on the flowering, fruiting and availability of food items during different months has already been carried out by Rajan *et al.* 1999.

TABLE 1
MARK AND RECAPTURE DATA OF *CYNOPTERUS SPHINX*

S. No.	Tag No.	Sex	Status of *C. sphinx* at the time of capture						Status of *C. sphinx* at the time of recapture						Maximum Distance
			Site	Date	Age	Rep	FA	B. Wt.	Site	Date	Age	Rep	FA	B. Wt.	
1.	367	F	A	11.x.1996	JU	NP	59.3	32.4	A	11.xi.1996	SA	NNP	64.5	36	—
2.	822	F	B	19.viii.1996	A	NP	67.7	35	C	29.xii.1996	A	NP	68.1	45	1 km
3.	387	F	C	2.xi.1996	SA	NNP	62.4	35	C	29.xii.1996	SA	NNP	66.7	43	—
4.	818	M	C	2.xi.1996	A	TP	68.1	55	C	29.xii.1996	A	TP	68.1	51	—
5.	252	F	C	2.xi.1996	SA	NNP	63.3	39	C	29.xii. 1996	SA	NNP	66.4	35	—
6.	43	M	D	17.xi.1995	SA	TNP	67.0	44	I	7.iv.1997	A	TP	68.1	48	400 m
7.	4	F	D	17.xi.1995	A	NNP	67.3	42	I	7.iv.1997	A	NP	67.4	50	400 m
8.	6	F	D	17.xi.1995	SA	NNP	67.2	44	I	7.iv.1997	A	NP	69.1	51	400 m
9.	8	F	D	17.xi.1995	SA	NNP	68.3	46	I	7.iv.1997	A	NP	66.2	45	400 m
10.	796	M	A	8.viii.1996	A	TNP	66.0	54	A	2.v.1997	A	TNP	66.4	49	—
11.	21	M	E	27.xii.1996	A	TNP	66.2	48	D	11.v.1997	A	TNP	67.5	49	—
12.	839	M	A	8.viii.1996	A	TNP	65.7	47	C	24.vi.1997	A	TP	70.5	51	7 km
13.	30	F	F	12.iii.1997	SA	TNP	66.2	45	A	30.vi.1997	A	TP	69.4	50	1 km
14.	120	M	A	2.v.1997	JU	GU	62.7	32	A	22.vii.1997	SA	TNP	70.3	44	—
15.	701	F	G	11.iv.1996	A	NNP	69.0	52	J	30.vii.1997	A	NP	70.6	66	4 km
16.	887	M	D	28.ii.1996	A	TNP	65.6	45	J	30.vii.1997	A	TNP	69.5	50	500 m
17.	99	F	H	7.iv.1996	SA	NNP	65.3	44	J	30.vii.1997	A	NP	66.7	48	50 m
18.	91	F	H	7.iv.1996	A	NP	70.1	54	I	31.vii.1997	A	PRG	67.3	59	—
19.	89	F	H	7.iv.1996	SA	NNP	69.2	46	I	31.vii.1997	A	LAC	71.6	45	—
20.	66	M	D	17.xi.1995	A	—	67.5	47	I	31.vii.1997	A	TP	70.4	52	400 m
21.	77	M	D	17.xi.1995	A	—	66.8	46	I	31.vii.1997	A	TP	69.3	42	400 m
22.	79	F	H	7.iv.1997	A	NP	71.1	49	I	15.ix.1997	A	NP	71.3	45	—
23.	260	M	H	31.vii.1997	A	TP	65.5	47	1	15.ix.1997	A	TNP	66.6	43	—
24.	239	F	I	30.vii.1997	JU	NP	65.6	34	I	15.ix.1997	SA	NNP	65.8	32	250 m
25.	70	F	J	7.iii.1996	A	NP	69.6	59	I	15.ix.1997	SA	NP	71.6	46	200 m
26.	86	M	H	7.iii.1996	A	TP	65.4	49	I	15.ix.1997	A	TP	72.8	49	—
27.	231	F	H	31.vii.1997	A	NP	72.8	52	I	15.ix.1997	A	NP	72.8	49	—
28.	259	M	H	31.vii.1997	A	TP	69.2	49	I	15.ix.1997	A	TP	69.2	47	—
29.	271	F	K	4.viii.1997	A	NP	69.1	43	I	15.ix.1997	A	NP	69.2	46	400 m
30.	246	M	H	31.vii.1997	SA	TNP	67.9	39	I	15.ix.1997	A	TP	64.5	45	—
31.	214	F	I	31.vii.1997	SA	NNP	70.5	46	I	15.ix.1997	A	NNP	70.5	41	250 m

NNP- Nipples not prominent, NP- Nipples prominent, TP- Testes prominent, TNP- Testes not prominent, PRG- Pregnant, LAC- Lactating, A- Adult, SA- Subadult, JU- Juvenile, FA- Forearm length, B.Wt.- Body weight

Compared to other species of bats in the study area, *C. sphinx* seemed to emerge from and return early to its roosts. The recapture of *C. sphinx* was not high because of our choice to erect mist-nets in the same site during the whole year. Our mist-netting experience for one year confirms that *C. sphinx* remembers capture sites and avoids flying into the same nets again.

The mist-netted samples from different places helped us to assess the distance traveled and the areas visited by the bats during foraging. In one such recapture, we caught a male bat 7 km away from the original banding site. Normally, males do not travel such long distances (Marimuthu *et al.* 1998). The flight could have been exploratory.

The poor condition of bats in the dry season by reducing net energy intake and reducing fat

stores could be an adaptation to reduce energy consumption during the lean time (Freed 1981, Noberg 1981). That is, individuals may let their weight drop in the dry season to reduce absolute energy requirement. Fleming (1988) reported that body mass in adults of both sexes of *Carollia perspicillata* changed seasonally. Adult *C. perspicillata* were generally lighter in the dry season than in the wet season. In male *C. sphinx*, no significant variation in body mass was observed during the year. Unlike the new world bats and temperate bats, generally no significant variation in body mass has been observed among tropical bats in an annual cycle, as seasonal changes in climate and food abundance are not marked in the tropics. This study corroborates the data collected during histological studies on the breeding habits of *C. sphinx* (Krishna and Dominic 1984, Sandhu 1986).

The capture of lactating mothers, immediately followed by capture of volant juveniles in mist-nets, shows that the young ones are "guided" by the mother bats during initial foraging attempts (Radhamani 1996). We observed that when individual volants are removed from the nets, they make distress calls, attracting the attention of several mother bats of the same species.

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FACTORS AFFECTING DISTRIBUTION OF THE SARUS CRANE *GRUS ANTIGONE ANTIGONE* (LINN.) IN KHEDA DISTRICT, GUJARAT[1]

Aeshita Mukherjee[2], C.K. Borad[2], B.M. Parasharya[2] and V.C. Soni[3]

(*With one text-figure*)

Key words: Distribution, paddy crop, sarus crane, *Grus antigone antigone*, visibility index, Kheda district

573 individuals of the sarus crane *Grus antigone antigone* were counted in an intensive ground survey, carried out in Kheda district, Gujarat, during August 1998. There was a distinct difference in the crane abundance amongst the tehsils (subdivisions) of Kheda district. Crane distribution in the district was determined by the physical structure of the habitat. The factors determining distribution within the district were (a) Pattern, height and water requirement of the crops, particularly the percentage of irrigated land for paddy crop (r = 0.47). (b) Standing water body with vegetation. (c) Visibility index or openness of the landscape (r = 0.46) influenced by vegetation height and density.

Introduction

The sarus crane *Grus antigone antigone* is restricted to a few northern and western states of India (Ali and Ripley 1983). Though once widespread, its population is now chiefly concentrated in Uttar Pradesh, Rajasthan, Gujarat and Madhya Pradesh (Gole 1989). Earlier, two large-scale attempts were made to estimate the sarus crane population in Gujarat State (Vaishnav 1985) and in the whole country (Gole 1989). In both cases, the population size was estimated on the basis of a few actual counts, local inquiry, and presence of wetland and cropped area available. Since no intensive survey of a single district was done, the actual head counts are not available, and factors affecting distribution are not known. The relative abundance of the sarus crane in different tehsils (subdivisions) of Kheda district was determined and the percentage of land under paddy crop was considered as a factor affecting distribution (Parasharya *et al.* 1989, 2000). To determine and assess the factors affecting distribution of the sarus crane within a district, the present study was taken up. The species is currently categorized as globally threatened, due to rapid population decline and other threats (Meine and Archibald 1996). The present study was, therefore, warranted to identify the factors determining its distribution in Kheda district, which holds the largest crane population in Gujarat State (Parasharya *et al.* 1996), and ultimately to develop a management strategy.

Study Area

Kheda district is situated in central Gujarat, an area of 7,194 sq. km, which is 3.7% of the total area of Gujarat. The district lies between two major rivers, Mahisagar on the eastern and Sabarmati on the western side. To the north is the boundary with Sabarkantha district. Ahmedabad district lies to the west and Panchmahal and Baroda on the eastern side. The southern boundary is attached to the Gulf of Khambhat. It is mainly plain, except for a small hilly area in Kapadvanj and Balasinor tehsils. The region has fertile *goradu* soil with alluvial, loamy sand.

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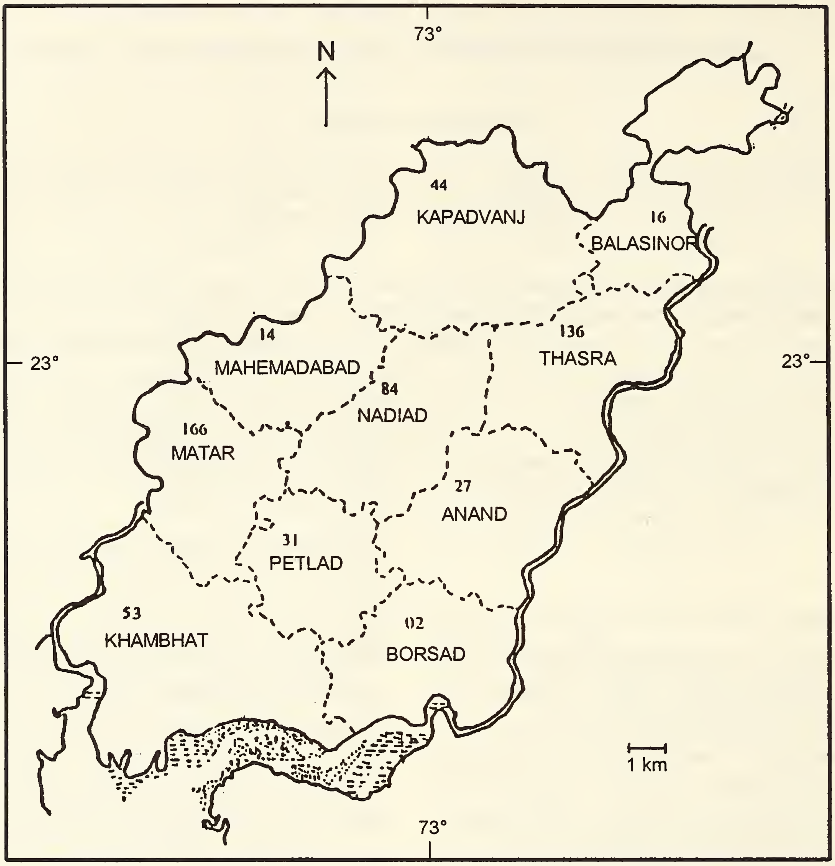

Fig. 1: Distribution of the Indian sarus crane in the tehsils of Kheda district, Gujarat

The district comprises of ten tehsils, a major area has canal irrigation, whereas in Kapadvanj and Balasinor tehsils, rain-fed farming is practiced. The total cultivated area is 6,58,495 ha (Director of Agriculture, Ahmedabad). The cropping pattern is as follows: During the monsoon, paddy (1,41,672 ha), pearl millet (1,45,916 ha) and tobacco (92,972 ha) are the major crops. Area under paddy in different tehsils is given in Table 1. In winter, wheat (60,335 ha) is the major crop. In summer, paddy and pearl millet were grown in irrigated areas.

The district is semiarid, with a tropical monsoon climate. The southwest monsoon arrives in the third week of June to September. The average maximum temperature recorded during May was 41.6 °C and during December 28.9 °C. The average minimum temperature recorded during January was 10.3 °C and during June 27.6 °C. Annual rainfall of the district was 557 mm in 1998.

Material and Methods

Sarus crane count was made from August 3 to 29, 1998 in different tehsils of Kheda district. The census route was decided on the basis of the tehsil road maps, ensuring that at least 75% of each tehsil was covered while traveling 250 km.

TABLE 1
SARUS CRANE SIGHTINGS IN KHEDA DISTRICT DURING AUGUST 1998 AND FACTORS AFFECTING ITS DISTRIBUTION

Tehsil	Survey dates	Number of cranes		% land under paddy	% land under irrigation	Visibility Index
	August 1998	Actually Seen	Claimed by Local people			
Anand	11-14	27	51	2.81	42.71	2
Balasinor	18-22	16	6	11.98	0.03	4
Borsad	15-16	2	2	32.91	20.23	1
Kapadvanj	8-15	44	42	7.63	0	3
Khambhat	7	53	49	31.65	48.79	5
Mahemadabad	25	14	44	0.01	2.33	2
Matar	4-7	166	246	42.73	36.84	4
Nadiad	26-29	84	47	32.58	12.82	3
Petlad	17-18	31	25	38.41	33.1	2
Thasra	20-24	136	97	22.04	18.85	3
Total		573	627			

This study was carried out in monsoon, particularly in August. The census time was decided on the basis of the following reasons. During the southwest monsoon, entire fields are inundated. Monsoon is also the breeding season of the crane, so they are distributed in suitable breeding habitats. Secondly, the crop height is low, and hence it is easy to locate the cranes from a long distance. Census was avoided on rainy days (Table 1).

We drove at slow speed, recording the cranes sighted. Their numbers were confirmed using 10 x 50 binoculars. Periodically, the vehicle was stopped to scan the area for cranes. The locals were questioned for their estimates of population size, and their perception about the presence of the crane.

Since the vegetation varied in each tehsil, the visibility ranged from 50-800 m from either side of the road. The distance at which the cranes were sighted varied in different tehsils, depending on the vegetation profile and the crop pattern. Based on this, a visibility index (range 1-5) was developed. The visibility index (V.I.) based on detectability range from the road was as follows: distance of visibility in metres; 0-50 = 1; 50-200 = 2; 200-500 = 3; 500-700 = 4; > 700 = 5. Data on the cropping pattern and land under irrigation was collected from the District Statistical Officer, Kheda district. Correlation analysis (Steel and Torrie 1980) was performed to test the impact of factors affecting crane distribution.

RESULTS

The cranes were recorded in all the 10 tehsils of Kheda district. However, their number varied. A total of 573 cranes were actually sighted. However, the locals claimed a total of 627 cranes to be existent in this area. Census across Kheda district (Table 1, Fig. 1) shows that the maximum number of cranes were sighted in Matar (166), Thasra (136) and Nadiad (84) tehsils. Some cranes were sighted in Borsad (2), Mahemadabad (14) and Balasinor (16) tehsils also. No trend could be established between the actual number of cranes sighted and the number claimed by the local people. However, the total number claimed was slightly higher than the actual sightings. The difference is too small to investigate further.

When the number of cranes sighted was correlated with the percent land under irrigated paddy and canal irrigation, and visibility index, a positive correlation ($r = 0.47$ *d.f.* 8, $P > 0.05$) was established between the crane number and the percent land under irrigated paddy. The paddy fields act as temporary wetlands and thus resemble the true wetland habitat of the cranes. Very weak positive correlation ($r = 0.25$ *d.f.* 8, $P > 0.05$) was observed between the crane number and the percent land under canal irrigation. This association was relatively weak compared to the former one, as several crops other than paddy which are not preferred by the sarus crane were included in this category. Some of the tehsils did not show a positive correlation at all, which compelled us to test an additional factor.

Visibility index and the distribution of crane in each tehsil showed a better correlation ($r = 0.46$ *d.f.* 8, $P > 0.05$). This suggested that an open habitat was required for the existence of crane. While conducting the census, we realised that the presence of inundated paddy and the land being under irrigation were not the only factors affecting the distribution of sarus crane. The height and density of the hedges of the crop field, and the type of crop grown, negatively affected the ability to detect the cranes. Hence, such areas were scanned more carefully. Tehsils with such a habitat had relatively few cranes. This confirmed non-preference of sarus cranes for habitat with high vegetation density and low visibility index (V.I. 1 and 2, i.e. detectability range up to 200 m). Therefore, a positive correlation between the visibility index and crane number can be deduced from our observations.

Discussion

Sarus crane distribution in the tehsils of Kheda district was patchy, depending upon the suitability of habitat. Even within a tehsil, the distribution was not uniform. A total of 573 cranes were sighted in the district. Eight tehsils were intensively surveyed, though relatively less effort was made in Mahemadabad and Khambhat tehsils. With an equal effort in these two tehsils, actual sightings would have certainly been higher.

This study was carried out in August, which is also the beginning of the crane's breeding season (Ali and Ripley 1983, Gole 1987, 1989 Parasharya *et al.* 1989), for which the cranes disperse over the agricultural landscape, particularly in the paddy growing areas. Due to the wide dispersal of the cranes and the crop growth, fewer cranes could be detected from the moving vehicle. Even in open habitats, cranes could be detected only up to 800 m on either side of the road. Hence, in tehsils like Matar, Thasra and Khambhat, several cranes may have been missed. It can be presumed that the actual number of cranes in Kheda district is much higher than the number reported here. Recently, Mukherjee *et al.* (1999) have established that for sarus crane census, summer is the most suitable period. Using two different census techniques, day and night roost count, the sarus crane population was estimated to be 457 to 548 in a 527 sq. km area around Matar tehsil alone (Mukherjee *et al.* 2001). In view of these results, if census in all the 10 tehsils of Kheda district is made during summer, a true picture of population size can be obtained. Summer census would also indicate relative improvement in the population estimation over monsoon, the cranes' breeding season.

Parasharya *et al.* (1989, 2000) estimated 1,508 sarus cranes in Kheda district, based on information collected through the Village Level Workers (VLW) of the state agricultural department. The crane numbers claimed by the local people during the current census are comparable with the numbers claimed by the VLW in 1989. The state forest department had

estimated 2,741 sarus cranes in Kheda district during 1984 (Vaishnav 1985). However, the season of census and technique was different. Compared to the population size projected earlier, the current figure of the crane sightings was certainly lower. An alarming decline in the distribution range and population size of the sarus crane was also reported earlier (Gole 1989). Density estimate of the sarus crane in Matar tehsil of Kheda district in August 1989 and 1995 on a fixed route had shown a decline of 15% of the population. Due to the restricted distribution, and reported rapid decline in the population, the sarus crane is categorized as a globally threatened bird species (Meine and Archibald 1996). A systematic census effort is urgently required.

That the sarus crane is a true wetland bird, is supported by the distribution pattern observed in different tehsils. Large manmade reservoirs linked with canals are abundant in Matar and Thasra tehsils, in which the highest number of cranes was estimated. The paddy fields are considered as temporary wetlands (Scott 1989, Gopal 1995). In the absence of natural wetlands, the sarus crane preferred and survived well in the paddy fields of Kheda district (Parasharya *et al.* 1989, 2000). Considering the per-centage of land under paddy crop as an index, we found a moderate positive correlation with the crane number in different tehsils. The sarus preferred paddy to other irrigated crops, so a weaker correlation was found with percent land under canal irrigation compared to the percent land under paddy crop. Inundated paddy fields are temporary wetlands, which provide feeding and breeding requirements of the cranes. The paddy crop usually does not grow above the height of the cranes; hence, it does not impede visibility and permits vigilance against predators. Such a situation is not found in other cereal crops like pearl millet and maize. The sandhill crane *Grus canadensis* also prefer cereal crops shorter than their own height (Sugden *et al.* 1988). Moreover, in paddy crop there is minimum human disturbance compared to other crops; this could be one of the reasons that paddy is preferred over other crops.

Visibility index of the tehsil (in effect, openness of the habitat) was another important factor determining the distribution of cranes. As in Borsad and Petlad tehsils, very high vegetation density (revealed from the V.I.) was the major limiting factor for crane distribution. A combination of high V.I. with greater percent land under irrigated paddy resulted in a greater number of crane sightings, showing that both the parameters determine habitat preference of the sarus crane.

In open habitat, it is convenient for the cranes to take off or to land. Greater height of the field hedge hampers their movement. Moreover, within dense vegetation, vigilance against predators is very poor. The whooping crane *Grus americana* also avoids areas with obstructions to visibility (Armbruster 1990). It can be concluded that the sarus crane is dependent upon the agricultural landscape, and its relative distribution was governed by the percentage of land under inundated paddy and the openness of the habitat.

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ELYTRAL VESTITURE AND ITS BIOSYSTEMATIC SIGNIFICANCE IN ENTIMINAE (CURCULIONIDAE: COLEOPTERA)[1]

V.V. Ramamurthy[2]

(*With two plates and thirty-seven text-figures*)

Key words: Elytral vestiture, biosystematics, Curculionidae, Entiminae, SEM investigations

Studies on the entimine weevil genera, namely *Myllocerus* Schoenherr of Otiorrhynchini, *Tanymecus* Germar, *Burmanicus* Supare, *Krauseus* Supare and *Lepropus* Schoenherr of Brachyderini, demonstrated that the elytral vestiture consists predominantly of flat scales, which overlap each other on the intervals of elytra, while the less predominant erect/sub-erect ones are elongate, found lining the striae or in the middle of intervals. There is enormous morphological diversity in the elytral vestiture and yet there is consistency at different hierarchical levels denoting its diagnostic value. It is concluded that elytral vestiture can help a taxonomist to take confident taxonomic decisions on the species diagnosis, revisions at generic and other levels, and monophyletic nature of taxa. Scanning electron microscope investigations have corroborated this conclusion. Incidentally, it has been shown that gold coating impairs the results as it defaces the finer structures.

Introduction

The Curculionidae are one of the largest group of weevils which, with their destructive potential, are capable of inflicting great economic damage to man. Entiminae is one such subfamily, containing many economically important genera. Many of these are large, complex, and perplexing to taxonomists; thus there is a need to identify additional taxonomic characters of diagnostic value. In 1916, while concluding his notes on the Indian Curculionidae, Marshall emphasized this and spelt out the importance of superficial hairs and scales, as these exhibit structural and morphological diversity. He also mentioned that comparatively little attention has been paid by systematists to the structure of scales, though these often exhibit good specific and even generic characters. Some attempts were made to study this character on the elytra referred to as "elytral vestiture" (Ramamurthy and Ghai 1988, Supare *et al.* 1990, Ramamurthy *et al.* 1992, and Poorani and Ramamurthy 1997). The present study is an attempt to integrate these findings, corroborate the same with Scanning Electron Microscope (SEM) investigations, and evaluate its utility in diagnostics.

Material and methods

The specimens selected for the study were examined under magnifications ranging from 6x to 160x. The elytral vestiture was studied *in situ* to know the type and arrangement, and to select characters for detailed examination. The Wild M8 Stereo Zoom Microscope was used for this. To study the details of the scales, the elytra was scratched with a minuten pin on to a cavity slide containing a drop of ethyl alcohol (mixed with glycerol to avoid instant drying). Gentle stirring with the minuten helped separate the scales. These were then covered with a cover-slip and examined under Leitz Ortholux II Interference Phase Contrast Microscope at magnifications from 200x to 400x. The illustrations were made using a drawing tube fitted with a mirror camera

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lucida. The microphotographs were made with a Wild MPS 45 microphotoautomat. SEM studies were done in a Carl Zeiss Digital Scanning Microscope, model DSM 962, capable of high resolution image storage, real time image processing and image recording on digital media, integrated with arrangements for critical point drying and gold coating. The key parameters namely magnification, micron marker bar, accelerating voltage and working distance are indicated in the data field in the pictures.

Results

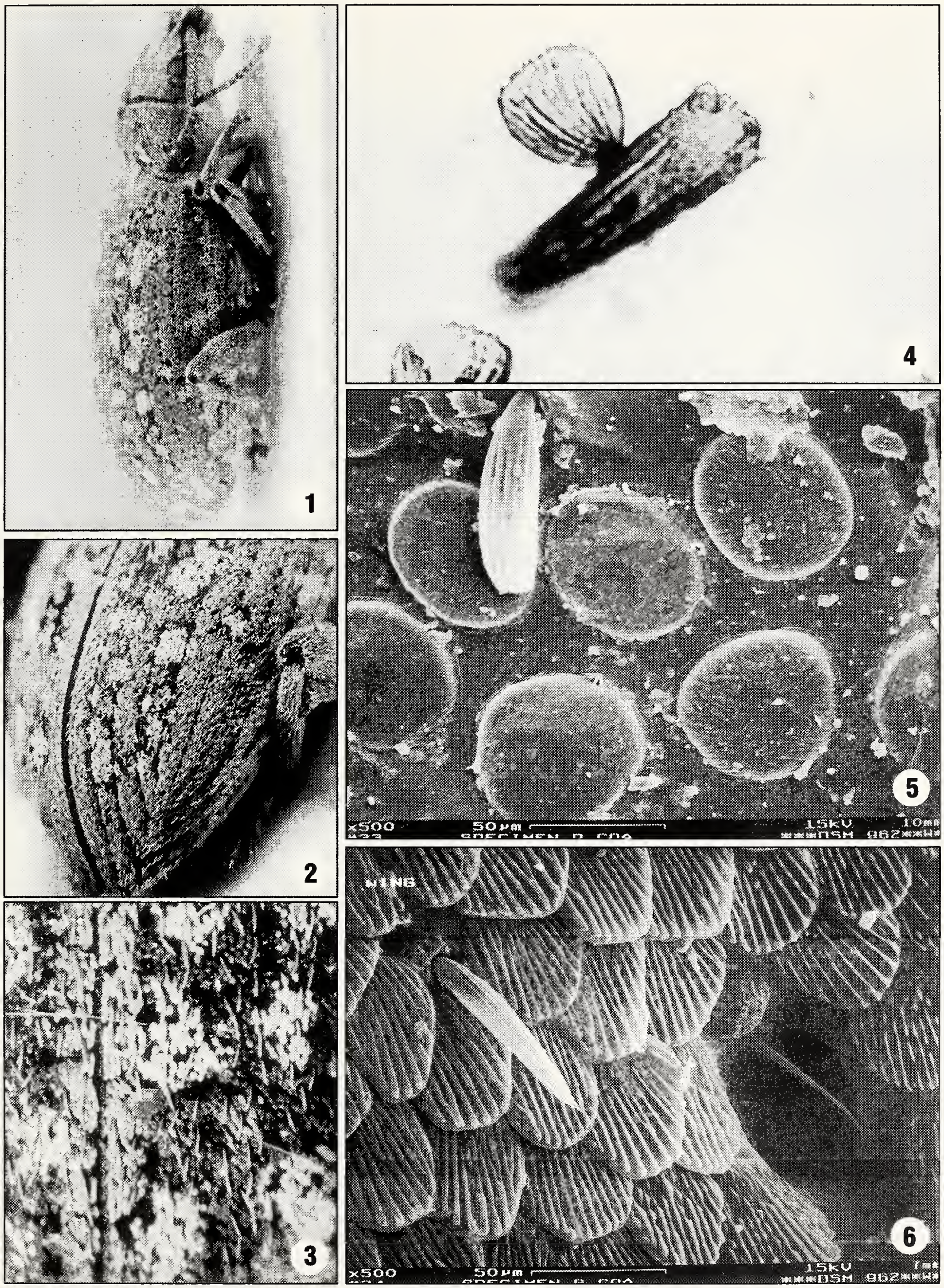
The preliminary examination of the superficial clothing in Curculionidae showed that the elytral vestiture is striking, consistent and diagnostically significant. At magnifications from 6x to 50x, this vestiture was seen in the form of scales, setae, hairs and fine pubescence, of which the scales are most apparent, as they cover the whole elytra, making it squamose and with various colour patterns (eg. *Myllocerus discolor* Fabricius, Plate 1, Figs 1, 2). In the subfamily Entiminae, the intervals of the elytra are almost always carpeted by these overlapping scales, which are always predominant, and supplemented with more or less regular rows of the less predominant elongate, erect or sub-erect scales. These frequently furnish excellent generic and/or specific characters (Plate 1, Fig. 3).

The predominant scales overlap each other, entirely cover the intervals and extend to the brim of the punctation of striae. These scales are always very flat, ovate or circular, rarely elongate oval, with or without pedicel, ridges or grooves, densely or sparsely clothed with short or long, thin or thick, straight or wavy hairs; in some the ridges extend beyond the apical margin too (Plate 1, Fig 4; Figs 11, 13; 15, 17, 18, 20, 25, 27, 29, 30, 32, 34, 35, 38, 39, 41, 43, 46). The less predominant are short or long, erect or sub-erect, recumbent or sub-recumbent, based on the angle with which they are attached to the surface of elytra. But they are always elongate, and mostly found on either margins of intervals lining the striae or in rows in the middle of intervals (Plate 1, Fig 4; Figs 12, 14, 16, 19, 21-24, 26, 28, 31, 33, 36, 37, 40, 42, 44, 45, 47). Marshall (1916) used the term setae for them, but they are also scales in the true sense. The morphological diversity of these scales varies between species, genera and tribes, as explained below.

In *Myllocerus pallipes* (Roelofs), the scales on the intervals are broadly ovate, disc-like, extremely convex, with margins inverted, pedicel distinct, ridges 6-8 (Fig. 11). The scales on the strial margins are elongate, short, conical, pedicel broad and distinct, grooves 3-4 (Fig. 12). All these agree with other species of *Myllocerus* Schoenherr. *M. procerus* Faust is characterized by the presence of discal spots, ovate or round shape, straight apical margin, with pedicel, ridges 8-10 (Figs 17, 18). The scales on the strial margins are elongate, spindle-shaped, with their apices curved (Fig. 26). Closely related species, namely *M. dentifer* Fabricius and *M. discolor* (Boheman) have an elytral vestiture as detailed below: in *dentifer*, scales on the intervals circular, with pedicel, apex straight, ridges 7-8 (Fig. 13), scales on the strial margins conical, grooves 4-6 (Fig. 14), while *discolor* has ovate scales with pedicel, apex narrowed and pointed, ridges 8-9 (Fig. 15), of which those on the strial margins are elongate, conical, curved, with 2-3 grooves (Fig. 16).

In *Tanymecus* Germar, species differ in having their flat scales clothed with thick, thin, long or short hairs and with or without pedicel (Figs 20-25, 27-29). *T. mandibularis* Marshall (Fig. 29), *hirticeps* Marshall (Fig. 25), *chloroleucus* (Wiedemann) (Fig. 27) and *circumdatus* (Wiedemann) (Fig. 20), all have their flat scales on the intervals ovate, with distinct, rounded pedicel, clothed with a few thick, short hairs (Fig. 29), thick, long hairs (Figs 25, 27) or dense, thin, short hairs (Fig. 20). In

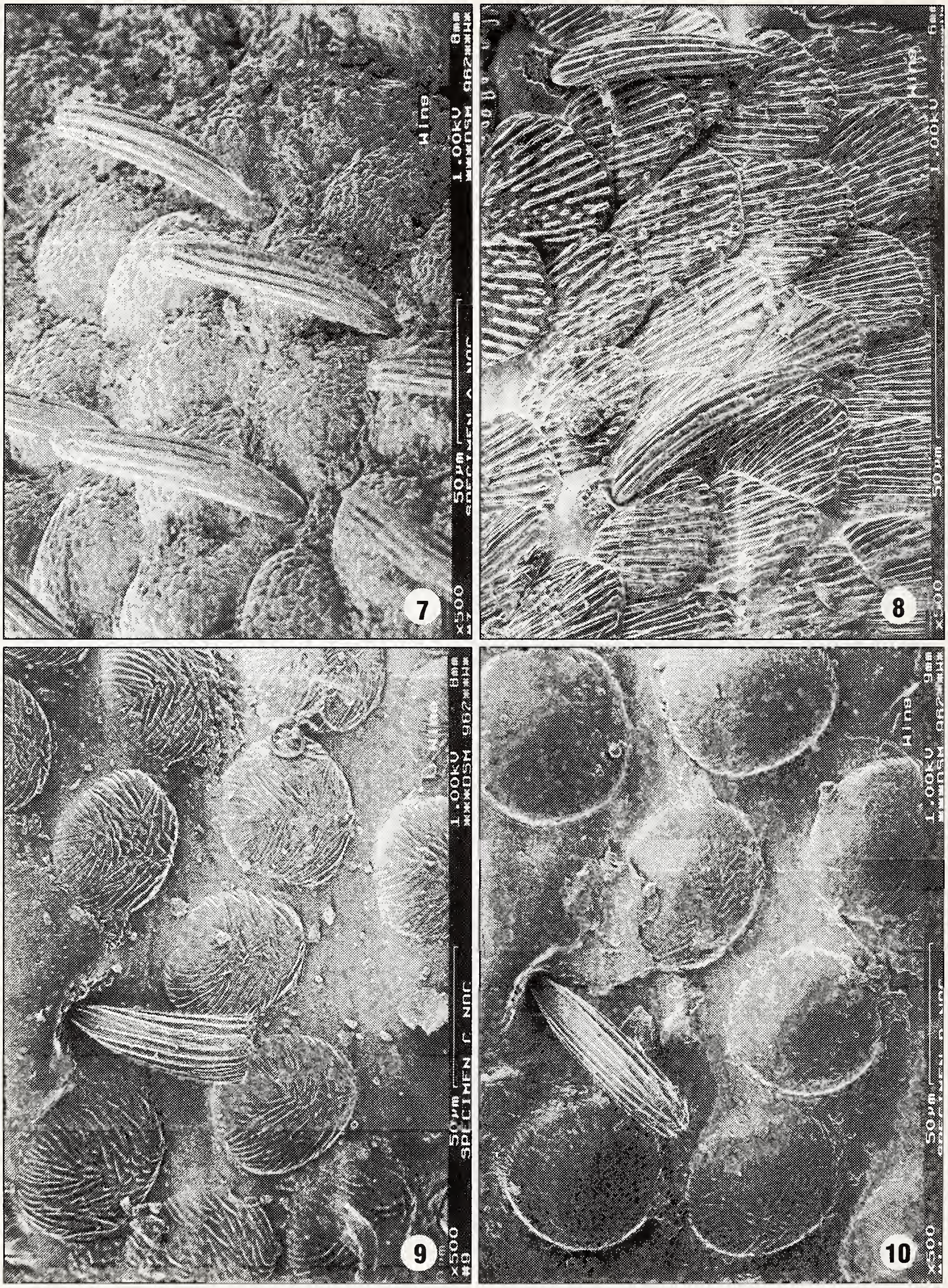
Ramamurthy, V.V.: Elytral vestiture PLATE 1



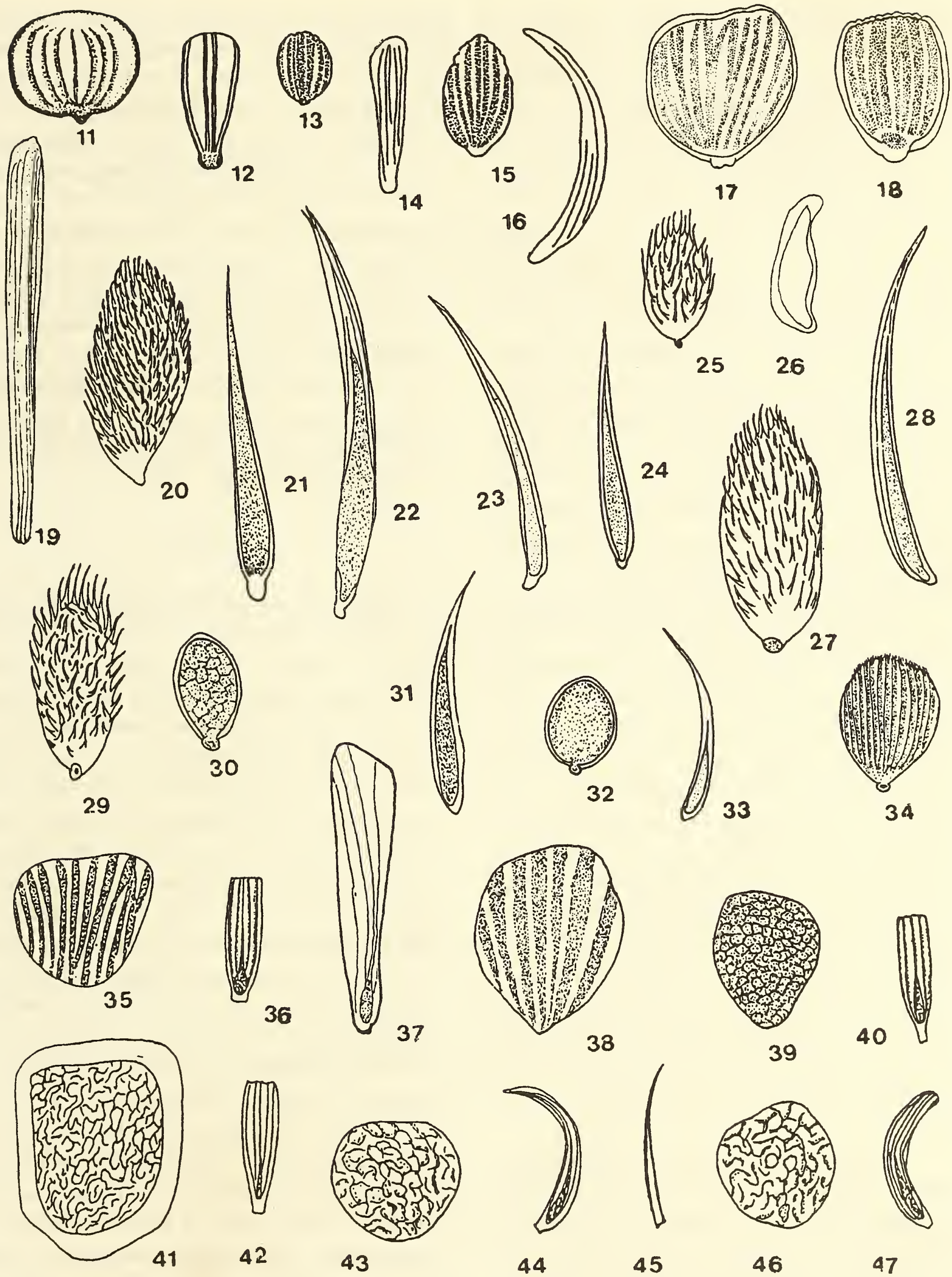
Figs 1-6: Elytral vestiture of Entiminae (for details see text)

Ramamurthy, V.V.: Elytral vestiture

PLATE 2



Figs 7-10: Elytral vestiture of Entiminae (for details see text)



Figs 11-47: Elytral vestiture of Entiminae (for details see text)

these, the scales lining the strial margins are conical, curved or straight, with an indistinct or distinct pedicel (Figs. 21-24, 28). *Burmanicus* Supare and *Krauseus* Supare have similar scales, except for the absence of hairs on flat scales, ovate or round, characteristic with peripheries distinctly demarcated, median area raised, surface reticulately smooth, with a distinct, rounded pedicel (Fig. 30, 32), their scales lining the strial margins/ middle of intervals conical, without a distinct pedicel (Figs 31, 33). In *Krauseus*, these scales are broadly ovate, rather disc-like, with base slightly narrowed with a distinct rounded pedicel, apex fringed with very thin, delicate hairs, median area with 13-15 ridges, some of these projecting slightly beyond apical margin (Fig. 34), other scales conical, but truncate at apex, base with a very small, indistinct pedicel, with 6-8 grooves (Fig. 19).

In *Lepropus* Schoenherr, the species *oculatus* (Heller) and *gestroi* (Marshall) have their flat scales subrectangular to subovate (Fig. 35), or ovate, narrowed at the base with a short, rounded pedicel, with 7-10 ridges (Fig. 38), while the elongate ones are curved, with or without pedicel, with 3-5 ridges (Fig. 36) or without any ridges (Fig. 37). In *Brachyaspistes* Schoenherr, these flat scales are ovate, subovate, subcircular with irregular impressions (Figs 43, 46), longer than broad, somewhat angular, with a raised boss in the middle, with irregular criss-cross impressions (Fig. 41), their scales on the strial margins elongate, gradually broadened towards apex, with 4-5 ridges and a pedicel (Figs 40, 42), curved, with a short pedicel, with 3-5 ridges (Figs 44, 47) or hairs or setae (Fig. 45).

SEM investigations on *Brachyaspistes femoralis* Fahraeus indicate that the flat scales are subcircular, their median area raised, and with irregular impressions (Plate 2, Fig. 7) and those on the strial margins characterized by 3-5 ridges. Likewise, *Lepropus chrysochlorus* (Wiedemann) has its scales ovate, with 8-15 ridges (Plate 1, Fig 6; Plate 2, Fig. 8), of which the ridges are clear in non-coated specimens (Plate 2, Fig. 8), while in coated specimens they get smothered, concealing the breaks in the ridges (Plate 1, Fig. 6). The basic green morph of *L. lateralis* (Fabricius) has their predominant scales subcircular with irregular, very fine ridges, less predominant ones curved, elongate, broader at apex than at base, with a pedicel, with 4-5 ridges (Plate 2, Fig. 9). The grey morph of *L. lateralis* showed similar scales except for the ridges becoming much finer (Plate 2, Fig. 10). When coated with gold for SEM, these fine ridges tend to get camouflaged, indicating that a gold coating may give misleading results in case of fine differences (Plate 1, Fig. 5).

Discussion

It can be concluded that entimine genera of different tribes have variations in elytral vestiture which confirm their placement at different suprageneric levels. In a complex genus like *Myllocerus*, it has been established that by utilizing this single character we can identify some species such as *procerus*. Elytral vestiture could be used to distinguish very closely related borderline species like *dentifer* and *discolor*, which are otherwise inseparable with customary taxonomic characters. It has been demonstrated that this character can aid revisions at generic level, like the synonymy of *Hyperstylus* Roelofs with *Myllocerus* (Ramamurthy *et al.* 1992), distinction of *Tanymecus*, *Krauseus* and *Burmanicus* (Supare *et al.* 1990), *Tanymecus* vs. *Esamus* Chevrolat (Ramamurthy and Ghai 1991), and *Lepropus* vs. *Brachyaspistes* (Ramamurthy *et al.* 1998). SEM studies have corroborated the authenticity of these taxonomic decisions. Incidentally, it was established that given certain conditions, there is no need to gold-coat the specimens, which defaces the finer features of the elytral vestiture. The present study confirms the findings of Lacordaire (1863) and

others, that the elytral vestiture can be renewed by the insect after they have been rubbed off, form a regular pattern, these are powdery secretions, their structure is specific, and is of great biosystematic significance, especially in Subfamily Entiminae of Curculionidae.

ACKNOWLEDGEMENTS

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A NEW SPECIES OF *HORALABIOSA* SILAS FROM A KERALA STREAM OF THE WESTERN GHATS[1]

J.A. JOHNSON AND R. SORANAM[2]

(*With two text-figures*)

Key words: *Horalabiosa*, Panniyar stream, Kerala

A new species *Horalabiosa arunachalami* was collected from a stream in Santhamparai hills, Western Ghats, Kerala. It is distinguished from other species of the genus in having 2 simple and 8 branched dorsal rays, and a poorly developed callus pad. It differs from *H. joshuai* in the absence of scales in the predorsal region, and differs from *H. palaniensis* in having fewer scales on the ventral side.

INTRODUCTION

The genus *Horalabiosa* Silas is represented by two species in India, which are endemic to the east flowing streams of the southern Western Ghats, Tamil Nadu. A very unique character of these fishes is the presence of a callus pad on the ventral side. External morphology seems closely related to the genus *Garra* Hamilton, but differs widely from it in the mouth shape, position and presence of post-labial callus pad in the mental region. Silas (1953) described *Horalabiosa joshuai* from the upper reaches of Tamiraparani river at Singampatti, Tamil Nadu. Later, it was synonymised with the genus *Garra* (Talwar and Jhingran 1991). Subsequently, Rema Devi (1992) redescribed the species after collecting a good number of specimens of *H. joshuai* from various altitudes in the headwaters of Tamiraparani. Recently, Rema Devi and Menon (1995) added one more species, i.e. *H. palaniensis* from Palani hills, Western Ghats, Tamil Nadu. During the present survey under the Western Ghats fish biodiversity programme, a new species of *Horalabiosa* was collected from Panniyar stream, Santhamparai hills of Idukki district, Kerala.

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STUDY AREA

Panniyar is a tributary of the major west flowing river, Periyar. The Panniyar stream originates from Santhamparai hill region of Idukki district, Kerala and drains into the Ponmudi reservoir. The sampling site is located between Pooparai (4 km from Santhamparai) at an altitude of 912 m above msl (9° 82' N; 77° 15' E). It is a third order stream mainly with large boulders and a rocky bed. There are 5-10 pools and 2-3 riffles in a 100 m stretch. Water temperature is 17 °C and air temperature is 23 °C. The natural riparian vegetation has been altered completely with the introduction of cardamom and tea plantations. Scattered old growth forests provide an instream cover of 30%. Cover refers to hiding cover for fish. It can be on, in, next to, or overhanging the water, if it is close enough to provide protection for fish (Armantrout 1992). Canopy cover (60-70%), mostly understorey and cardamom plantation, extends to the stream side in some areas.

MATERIAL AND METHODS

Fishes were collected using gill nets, drag nets and scoop nets. All specimens are preserved in the Sri Paramakalyani Centre for Environmental Sciences, Manonmaniam Sundaranar University, Alwarkurichi, Tamil Nadu, India. The morphometric measurements

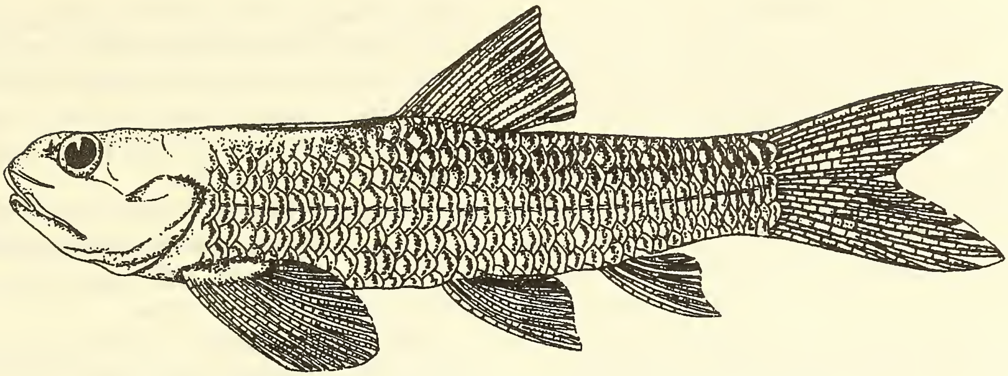

Fig. 1: Lateral view of *Horalabiosa arunachalami*, Holotype 54 mm SL

were studied using standard methods (Hubbs and Lagler 1964).

Horalabiosa arunachalami sp. nov.
(Figs 1-2)

Holotype: ZSI/SRS F. 5324, 54 mm standard length from a tributary of Panniyar stream, above Ponmudi reservoir at Santhamparai hills, Idukki district, Kerala, India. Alt. 912 m, 9° 82' N; 77° 15' E, Coll. M. Arunachalam, J.A. Johnson and R. Soranam, 16.v.1996.

Paratypes: 7 specimens, SPKCES F. 2, 25 to 30 mm SL collected from the same locality on the same day. All have been preserved in Sri Paramakalyani Centre for Environmental Sciences, Manonmaniam Sundaranar University.

Materials examined: ZSI/SRS F. 3909 - Holotype *H. palaniensis* 77.0 mm SL, Palani Hills, Western Ghats. *H. joshuai* 10 exs., 70 to 45 mm SL, type locality Manimuthar, Tamiraparani river, Tirunelveli district, from our own collections and the specimens are preserved in SPK Centre for Environmental Sciences, Manonmaniam Sundaranar University, Alwarkurichi, Tamil Nadu.

Diagnosis

Horalabiosa arunachalami is distinguished from the other two known species by its 2 simple and 8 branched rays in the dorsal and poorly developed post-labial callus pad. Additionally, it is distinguished from *H. joshuai* by the absence of predorsal scales and by having a larger eye (eye diameter 3.62 vs. 4.81 in HL). *H. arunachalami* differs from *H. palaniensis*, in having very few scattered scales on the ventral side and a larger head (Head length 3.63 vs. 4.24 in SL).

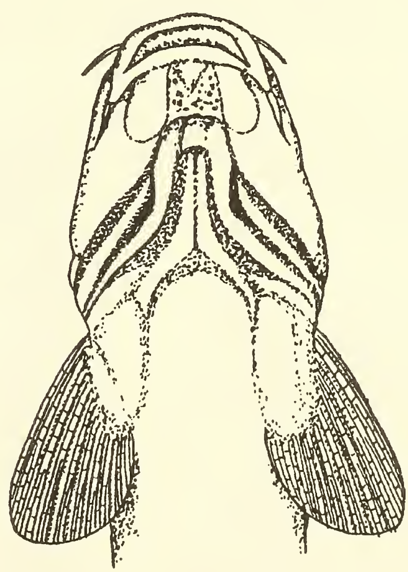

Fig. 2: Ventral view of head of *Horalabiosa arunachalami*

Description

D.2/8; P.1/13; V.1/7; A.1/5; C.19; L.l. 34-35; L.tr.3.5, 2.5. Predorsal scale absent. Body moderately elongate; dorsal profile slightly compressed, its depth 5.42 (4.88-6.28) in SL; head somewhat depressed, rounded anteriorly, its length 3.63 (3.33-4.20) in SL. Eye large, lateral in position, not visible from ventral side, its diameter 3.62 (3.25-3.75), interorbital width 2.41 (2.20-2.60), snout length 2.93 (2.72-3.25) in length of head. Rostral groove in front of the mouth well developed and separate upper lip from the rostrum; lips thick, fleshy and continuous at angles. Post-labial callus pad thin, poorly developed, with minute papillae. The rostral and maxillary barbels are well developed, maxillary barbels are longer than rostral and extend beyond the post-orbit of eye. Dorsal fin originates well before the origin of pelvic fin and it is inserted midway between the tip of the snout and base of caudal fin.

Fins: Pectoral fin oval, horizontally placed, its length 4.93 (4.28-5.50) in SL; 1.36 (1.22-1.62) in HL. Pelvic small, not reaching vent, its length 5.72 (5.05-6.3) in SL; 1.57 (1.37-1.85) in HL. Vent situated close to the anal fin, distance from vent to anal fin 3.70 (2.80-4.05) in distance from pelvic fin. Lateral line complete, with 34-35 scales. For further morphometric data, see Table 1.

Colour: Body light greenish-yellow, darker above. Ventrally dull white. No markings on the body. After preservation, body light yellowish-brown and ventrally pale yellow.

Etymology: Named in the honour of Prof. M. Arunachalam, Manonmaniam Sundaranar University, in appreciation of his interest in various aspects of stream fishes.

Discussion

The known species of *Horalabiosa joshuai* and *palaniensis* are exclusively from eastward flowing streams of the Western Ghats in Tamil Nadu. The new species *H. arunachalami* represents the fauna from a westward flowing stream of the Western Ghats, Kerala, which is of special interest, showing the distribution of the genus *Horalabiosa* in the southern part of the

Table 1

MORPHOMETRIC DATA OF *H. ARUNACHALAMI* SP. NOV. COMPARED WITH *H. JOSHUAI* AND *H. PALANIENSIS*

Morphometric Characters Proportions	*H. arunachalami* sp. nov. Present (n=8)		*H. joshuai* type locality (n=10)		*H. palaniensis* Holotype
	Range	Mean	Range	Mean	
Standard length / Body depth	4.88-6.28	5.42	4.66-6.57	5.52	5.83
Standard length / Head length	3.33-4.20	3.63	3.04-3.92	3.57	4.24
Head length / Eye diameter	3.25-3.75	3.62	3.66-5.75	4.81	5.78
Head length / Interorbital width	2.20-2.60	2.41	2.20-2.87	2.50	2.64
Head length / Snout length	2.72-3.25	2.93	2.80-3.28	3.11	5.56
Head length / Pectoral fin	1.22-1.62	1.36	1.08-1.53	1.27	1.21
Head length / Pelvic fin	1.37-1.85	1.57	1.30-1.76	1.50	1.51
Standard length / Pectoral fin	4.28-5.50	4.93	3.83 -5.00	4.53	6.42
Standard length / Pelvic fin	5.05-6.30	5.72	4.60-5.38	5.07	6.09
Standard length / Predorsal distance	1.80-2.07	1.92	1.89-2.03	1.98	1.98
Pelvic to vent / Distance to anal fin	2.80-4.05	3.70	2.60-3.33	2.98	4.36
Length of caudal peduncle / Height of caudal peduncle	1.33-2.00	1.54	1.25-1.60	1.46	1.64

Western Ghats. Moreover, the species coexists with other bottom-dwelling fishes like *Garra*, *Homaloptera* and *Noemachilus* species.

ACKNOWLEDGEMENTS

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ON THE INDIAN SPECIES OF *TRICHOMALOPSIS* CRAWFORD (HYMENOPTERA : CHALCIDOIDEA : PTEROMALIDAE)[1]

P.M. SURESHAN[2] AND T.C. NARENDRAN[3]

(*With thirty-seven text-figures*)

Key words: Chalcidoidea, Pteromalidae, *Trichomalopsis* new species

The Indian species of *Trichomalopsis* Crawford are reviewed. These include *T. apanteloctena* (Crawford) and *T. deplanata* Kamijo & Grissell and six new species *T. acarinata* sp. nov., *T. nigra* sp. nov., *T. ovigastra* sp. nov., *T. thekkadiensis* sp. nov., *T. neelagastra* sp. nov., and *T. travancorensis* sp. nov. A key to the Indian species of *Trichomalopsis* is also provided.

INTRODUCTION

Trichomalopsis Crawford, a species-rich genus of Pteromalidae, is best known from Europe and North America. As currently understood, the genus is composed of nearly three dozen species, largely Holarctic and Oriental (Kamijo and Grissell 1982). Graham (1969) provided the most recent key to European and North American species. Kamijo and Grissell (1982) worked on the Oriental species associated with rice fields. Boucek (1988) synonymised *Metadicylus* Girault under *Trichomalopsis*.

During our studies on the Indian Pteromalidae, a large number of specimens belonging to *Trichomalopsis* were collected mainly from Kerala. The studies revealed 8 species, which include *T. apanteloctena* (Crawford) and *T. deplanata* Kamijo & Grissell, already known from the region, and 6 new species. Besides describing the new species, a key to the Indian species of *Trichomalopsis* is also provided.

The terminology generally follows that of Graham (1969). In addition, the antennal funicle segments are numbered F1 through F6 and gastral tergites T1 to T6, beginning with the first after the petiole and the last before epipygium. The following abbreviations are also used: OOL - Ocellar ocular distance; POL - Posterior ocellar distance; SMV - Submarginal vein; MV - Marginal vein; PMV - Postmarginal vein; and STV - Stigmal vein.

The type specimens are kept in the collections of the Western Ghats Field Research Station, Zoological Survey of India, Calicut.

Trichomalopsis Crawford

Trichomalopsis Crawford, 1913, *Proc. U.S. natn. Mus.*, 45: 251 (type species: *Trichomalopsis shirakii* Crawford).

Eupteromalus Kurdjumov, 1913, *Russk. Ent. Obozr.*, 13:12 (type species *Pteromalus nidulans* Thomson)

Nemicromelus Girault, 1917, *Descr. Hym. Chalcid. Var. Observ.*, V: 4 (type species: *Merisus subapterus* Riley)

Metadicylus Girault, 1926. *Insecutor, Inscit menstr.*, 14: 71 (type species *Metadicylus australiensis* Girault)

KEY TO THE INDIAN SPECIES OF GENUS *Trichomalopsis* CRAWFORD

1. Lower margin of clypeus incised medially (Fig. 3); head in dorsal view thick, 1.85 to 1.95x as broad as long (Fig. 2); occipital carina strongly curved medially (Fig. 1) .... *apanteloctena* (Crawford)

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— Lower margin of clypeus only weakly emarginate (Figs 4, 20); head not very thick in dorsal view; if thick (1.9 to 2x as broad as long) then lower margin of face as in Fig. 4; occipital carina not strongly curved medially as above 2

2. Lower margin of face on either side of clypeus curved and projected below level of lower margin of clypeus (Fig. 4); head 1.9 to 2x as broad as long; flagellum in female stout (Fig. 5) .... *deplanata* Kamijo & Grissell

— Lower margin of face not projecting below level of lower margin of clypeus; head 2 to 2.1x as broad as long; flagellum not stout 3

3. Gastral petiole almost as long as nucha, weakly sculptured (Figs 13, 16); propodeum with post spiracular sulcus without transverse ridge; legs with coxae not concolorous with thorax, yellowish-brown or brownish-yellow 4

— Gastral petiole strongly transverse and unsculptured; post spiracular sulcus with a distinct transverse ridge; legs with coxae mostly concolorous with thorax 5

4. Pronotal collar weakly and irregularly margined or immargined; scape 0.9x eye length; pedicel plus flagellum almost as long as head width; T1 of gaster reaching only a little more than one third length (Fig. 18); temple length 0.5x eye length; head and thorax greenish-black with metallic reflection; antennae paler .... *acarinata* sp. nov.

— Pronotal collar weakly but sharply margined except at sides; scape as long as eye; pedicel plus flagellum 0.84x head width; T1 reaching almost half length of gaster (Fig. 14); temple narrow, length 0.4x eye length; head and thorax black with little reflection; antennae darker .... *nigra* sp. nov.

5. Gaster oval; ovipositor sheaths strongly protruding (Fig. 24); head in dorsal view with temples rounded (Fig. 19); median area of propodeum broad (Fig. 23); 1.3x as broad as long; plicae not very sharp .... *ovigastra* sp. nov.

— Gaster more elongated (Figs 9, 30, 37), ovipositor sheaths not strongly protruding as above; head in dorsal view different (Figs 6, 26, 32) with temples not much rounded; median area of propodeum less broad, 1.1 to 1.2x as broad as long; plicae more sharp 6

6. Propodeum with plicae very sharp, reaching tip of nucha; nucha more constricted; median carina strong (Fig. 8); T1 of gaster reaching only one third of length (Fig. 9); head in dorsal view with temples shorter (Fig. 6), length 0.5x eye length; pronotal collar irregularly margined .. .. *thekkadiensis* sp. nov.

— Propodeum with plicae not sharp as above, at least slightly incomplete towards the end of nucha (Figs 29, 35); median carina not very strong; temples longer, 0.7x as long as eye (Figs 26, 32); T1 occupying little beyond or before half length of gaster (Figs 30, 37); pronotal collar weakly but more regularly margined ... 7

7. Gaster (Fig. 30) 1.8x as long as broad and longer than thorax; T1 occupying little less than half length, with only slight metallic blue gloss dorsally; nucha less convex in profile (Fig. 27); scape little shorter than eye (0.9x)................ .... *travancorensis* sp. nov.

— Gaster (Fig. 37) 1.6x as long as broad, and as long as thorax; T1 occupying little beyond middle with bright metallic blue gloss dorsally; nucha more convex in profile (Fig. 33); scape as long as the eye .... *neelagastra* sp. nov.

Description of species

Trichomalopsis apanteloctena (Crawford) (Figs 1-3)

Trichomalopsis apanteloctena Crawford, 1911. *Proc. U.S. natn. Mus.*, *39*: 618.

Eupteromalus parnarae Gahan, 1919. *Proc. U.S. natn. Mus.*, *56*: 522.

The species can be identified by the following characters: Lower margin of clypeus rather deeply incised medially (Fig. 3); striation

on clypeus extending to lower margin of eyes and to malar sulcus; both mandibles with four teeth; head thick in dorsal view, 1.85 to 1.95x as broad as long (Fig. 2); occipital carina sharp, in posterodorsal view strongly curved medially (Fig. 1). Antennae with combined length of pedicel and flagellum in female 0.8 to 0.93x and in males 0.95 to 1.05x width of head. Pronotal collar indistinctly margined. Forewing with MV 1.55 to 2.1 x STV. Gaster 1.7 to 2x as long as broad.

Material examined: 8 Females, Kerala: Sreekariyam (Trivandrum), 25.ii.1989; 7 Females, Shertallai, 27.ii.1989; 1 Male, Kappil (Trivandrum), 26.ii.1989; 9 Females, 1 Male, Tenjipalam (Malappuram), ?.xi.1988; 2 Females, Attingal, 23.ii.1989; 2 Females, Ernakulam, 9.ii.1989; 6 Females, Kovalam, 24.ii.1989; 1 Female, Ochira (Quilon), 26.ii.1989; 3 Females, Valayar, 27.ii.1989; 3 Females, Tenjipalam, 24.xi.1988; 1 Female, Pamba, 21.xi.1997; 1 Female, Kadakattupara (Malappuram), 9.xi.1988; 1 Female, Chavara, 22.ii.1989; 2 Females, Silent Valley, 9.xii.1997; 5 Females, Elamathkavalai (Shertallai), 27.ii.1989; 1 Female, Kazhakuttom, 25.ii.1989; 1 Female, Varkala, 26.ii.1989, Coll. P.M. Sureshan.

Distribution: India (Kerala, Tamil Nadu, Karnataka,), Bangladesh, Korea, Malaysia, China, Japan, Taiwan, Philippines and Formosa.

Biology: Reared from *Cnaphalocrocis medinalis* (Guenee) (Lepidoptera: Pyralidae), *Pelopidas mathias* (Fabricius) (Lepidoptera: Hesperidae) in India.

Trichomalopsis deplanata Kamijo & Grissell (Figs 4 & 5)

Trichomalopsis deplanata Kamijo & Grissell, 1982: *Kontyu* 50: 84.

The diagnostic characters of the species are: Length 1.5-2.4 mm. Head in front view transverse, 1.3x as broad as high; lower margins of face on either side of clypeus curved and projecting below lower margin of clypeus (Fig. 4); clypeus with lower margin weakly emarginate; both mandibles with four teeth; striae of clypeus extending almost to lower margin of eyes and to malar sulcus. Antennal toruli situated distinctly above level of lower edge of eyes; scape much shorter than eye length, almost reaching lower edge of median ocellus; flagellum stout (Fig. 5); combined length of pedicel and flagellum about 0.8x width of head. Pronotal collar not margined anteriorly. Propodeum with median carina not very strong; plicae sharp throughout; spiracular sulcus with a transverse ridge at middle. Forewing with MV 1.45 to 1.85x STV and little longer than PMV. Gaster ovate, about as long as thorax; 1.3 to 1.4x as long as broad; T1 occupying one-third length of gaster or more.

Material examined: 5 Females, 1 Male, Kerala: Ranni, 24.xi.1988; 2 Females, Tenjipalam (Malappuram), ix.1988; 1 Female, Thekkady, 14.ix.1986; 1 Female, 1 Male, Vayalar, 27.ii.1989, Coll. P.M. Sureshan.

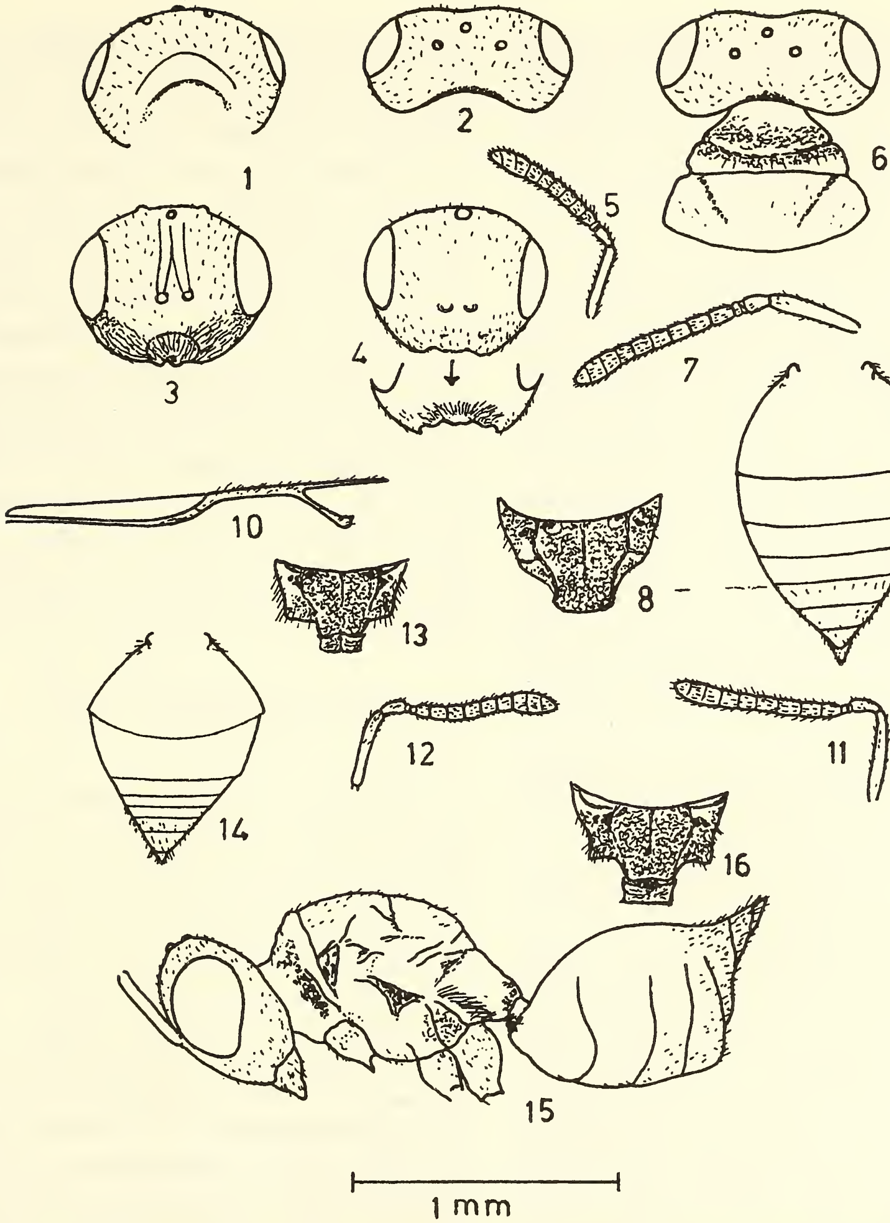
Distribution: India (West Bengal, Kerala), Japan, Korea, China.

Biology: Reared in India from Tachinid puparium on paddy.

Trichomalopsis thekkadiensis sp. nov. (Figs 6-11)

Female: Length 1.6-2.7 mm. (Holotype 2.4 mm). Bluish-green with metallic gloss; bronze-like gloss on thorax. Antennae with scape and pedicel testaceous, flagellum pale brown. Coxae concolorous with thorax, remainder of legs testaceous with tips of tarsi brown. Tegulae testaceous; wings hyaline; veins pale yellow.

Head (Fig. 6): Width 1.2x thorax; in dorsal view width 2x length and in front view width 1.3x height; POL 1.3x OOL; temple length 0.5x eye length; strongly converging behind eyes; eyes separated by 1.4x their height; malar space length



Figs 1-3: *Trichomalopsis apanteloctena* (Crawford) Female: 1. Head in posterodorsal view, 2. Head in dorsal view, 3. Head in front view;
Figs 4-5: *Trichomalopsis deplanata* Kamijo & Grissell Female: 4. Head in front view, 5. Antenna;
Figs 6-11: *Trichomalopsis thekkadiensis* sp. nov. Female: 6. Head and part of thorax in dorsal view, 7. Antenna, 8. Propodeum, 9. Gaster in dorsal view, 10. Forewing venation, 11. Male antenna;
Figs 12-14: *Trichomalopsis nigra* sp. nov. Female: 12. Antenna, 13. Propodeum and petiole, 14. Gaster in dorsal view;
Figs 15-16: *Trichomalopsis acarinata* sp. nov. Female: 15. Body in profile, 16. Propodeum and petiole

0.7x eye length; clypeus weakly emarginate anteriorly, striated, striae extending near lower margin of eyes; head otherwise moderately reticulate, finer on lower part. Antennae (Fig. 7) inserted above lower margin of eyes; scape almost as long as eye, almost reaching just above median ocellus; pedicel twice as long as wide; combined length of pedicel and flagellum 0.9x head width; club as long as 2.5 preceding segments combined.

Thorax: (Fig. 6) raised reticulate, length 1.7x width; pronotal collar irregularly margined. Mesoscutum width 2.4x length. Scutellum 1.2x as wide as long, similarly sculptured as on mesoscutum. Propodeum (Fig. 8) relatively long, about as long as scutellum medially; median area raised reticulate, sides finely reticulate; plicae strong, complete; median carina distinct; nucha highly constricted; callus sparsely hairy. Forewing (Fig. 10) with basal part bare; MV about 1.5x STV and very little longer than PMV. Relative lengths of SMV, MV, PMV and STV as 37: 13: 12.5: 8.5.

Gaster (Fig. 9): Length 1.6x width; slightly longer than thorax; T1 occupying about one third length of gaster.

Male: Length 1.7-2 mm. Similar to female but differs in having short gaster and antenna with longer pubescence.

Material examined: Holotype: Female, India, Kerala, Thekkady, 12.v.1986, Coll. T.C. Narendran & party. Allotype: Male, Kerala, Tenjipalam (Malappuram), 24.xi.1988, Coll. P.M. Sureshan. Paratypes: Kerala: 5 Females, Kayamkulam, 21.ii.1989; 5 Females, Varkala, 26.ii.1989; 3 Females, Vayalar, 27.ii.1989; 9 Females Kappil (Trivandrum), 26.ii.1989; 2 Females, Neendakara, 22.ii.1989; 4 Females, Ranni, 24.xi.1988; 3 Females, 1 Male, Tenjipalam (Malappuram), 24.xi.1988; 3 Females, Ernakulam, 9.ii.1989; 1 Female, Kovalam, 24.ii.1989; 1 Female, Edakkara, (Malappuram), 24.iv.89; 1 Female, Sreekariyam, 25.ii.1989; 1 Female, Madappally (Calicut), 30.x.1988; 2 Females, Attingal, 23.ii.1989; 1 Female, Parambilpeedika (Malappuram), 10.xi.1988; 1 Female, Elamathkavala (Shertallai), 27.ii.1989; 2 Females, Kazhakuttom, 25.ii.1989, Coll. P.M. Sureshan.

Remarks: This species closely resembles *T. shirakii* Crawford, but differs from it as follows: 1. temple length 0.5x eye length (in *shirakii* temple length one quarter or slightly more of eye length) 2. scutellum longer than mesoscutum, 1.2x as wide as long (scutellum as long as mesoscutum and slightly transverse in *shirakii*) 3. propodeum without a deep fovea behind spiracle; nucha half as long as propodeum and not well defined in front (propodeum with a deep fovea behind spiracle, nucha little shorter than half length of propodeum and well defined in front in *shirakii*) 4. propodeum with bronze-like gloss like other areas of thorax (propodeum without such gloss in *shirakii*).

Trichomalopsis nigra sp. nov.
(Figs 12-14)

Female: Length 1.5-2 mm (Holotype 2 mm). Blackish to bluish-black with slight metallic reflection; scape pale brown on basal two third, tip of scape and remainder of antenna dark brown. Legs testaceous except base of hind coxae blackish; tarsi darker at tip. Tegulae pale brown; wings hyaline; veins pale yellow.

Head: Width 1.2x thorax; in dorsal view width 2.1x length and in front view width 1.4x height; temple length 0.4x eye length; POL 1.3x OOL; eyes separated by 1.54x their height; malar space 0.7x eye length; clypeus anteriorly weakly emarginate, striate; head otherwise moderately reticulate; Toruli separated by half their diameter, placed only slightly above lower edge of eyes; scape (Fig. 12) as long as eye, reaching level of vertex; combined length of pedicel and flagellum 0.84x head width; second anellus a little longer than first, club a little shorter than 3 preceding segments combined.

Thorax: Length 1.4x width; pronotal collar sharply margined, except at sides, with broad smooth strip posteriorly. Mesoscutum width 2.4x length, moderately reticulate. Scutellum convex, longer than mesoscutum; frenal furrow vague. Metanotum with area between hind margin of scutellum and dorsellum narrow with several longitudinal carinae. Propodeum (Fig. 13) with median area reticulate as on scutellum; median carina weak; plicae not sharp; nucha convex; spiracular sulcus shallow, without transverse ridge; callus moderately hairy. Forewing with basal cell and vein bare. Relative lengths of SMV, MV, PMV and STV as 26: 11 : 10.5 : 7.

Gaster: Petiole (Fig. 13) as long as nucha, weakly sculptured; gaster shorter than thorax (Fig. 14), length 1.4x width; T1 occupying almost half length.

Male: Unknown.

Material examined: Holotype: Female: India, Kerala, Shertallai (Kanhikuzhy), 27.ii.1989, Coll. P.M. Sureshan. Paratypes: Kerala: 2 Females, Sreekariyam, 25.ii.1989; 1 Female, Kayamkulam, 21.ii.1989; 1 Female, Ochira, 26.ii.1989; 1 Female, Chungathara (Malappuram), 24.iv.1989; 2 Females, Attingal, 23.ii.1989; 1 Female, Elamathkavalai (Shertallai), 27.ii.1989; 1 Female, Kovalam, 24.ii.1989, Coll. P.M. Sureshan.

Remarks: This species closely resembles *T. oryzae* Kamijo & Grissell but differs from it in having antennal toruli placed only slightly above lower margin of eyes; scape as long as eye; F1 narrower than pedicel; second anellus not much longer than first; malar space 0.7x eye length; eyes separated by 1.5x their height; mesoscutum width 2.4x length; gaster with T1 occupying almost half length (in *oryzae* toruli distinctly above lower edge of eyes; scape 0.83 to 0.92x eye length; F1 slightly wider than pedicel; second anellus much longer than first; malar space only 0.45x eye length; eyes separated by 1.25x their height; mesoscutum twice as broad as long and T1 occupying more than one third length of gaster in *oryzae*).

Trichomalopsis acarinata sp. nov.
(Figs 15-18)

Female: Length 1.3-2.0 mm (Holotype 1.6 mm). Head and thorax dark green; thoracic dorsum with slight bronze-like gloss; gaster dark brown. Scape yellowish-brown, darker at tip; remainder of antenna dark brown. Legs yellowish-brown with coxae darker. Tegulae pale brown; wings hyaline; veins pale yellowish-brown.

Head (Fig. 15): Width 1.3x thorax; in dorsal view width 2.1x length and width 1.3x height in front view; POL 1.3x OOL; temple length half of eye length; malar space 0.6x eye length; eyes separated by 1.3x their height; clypeus striated, anterior margin weakly emarginate; toruli placed only a little above lower margin of eyes; scape (Fig. 17) 0.9x eye length, reaching level of vertex; pedicel plus flagellum almost equal to head width; club a little shorter than 3 preceding segments combined.

Thorax (Fig. 15): Length 1.5x width; pronotal collar weakly margined or immargined. Mesoscutum width 2.3x length. Scutellum less convex, similarly sculptured as on mesoscutum; frenal groove vague. Metanotum with area between hind margin of scutellum and dorsellum very narrow with longitudinal carinae. Propodeum (Fig. 16) with median area similarly sculptured as on scutellum; median carina weak; plicae not sharp; spiracles oval; postspiracular sulcus without transverse ridge; callus moderately hairy. Forewing with relative lengths of SMV, MV, PMV and STV as 14.5 : 6 : 5 : 4.5.

Gaster: Petiole (Fig. 16) almost as long as nucha, sculptured; gaster (Fig. 18) ovate, length 1.5x width; T1 occupying little more than one third length.

Male: unknown.

Material examined: Holotype: Female: India, Kerala, Calicut University Campus, 2.v.1986, Coll. T.C. Narendran & party; Paratypes: Kerala: 5 Females, Kayamkulam, 21.ii.89; 3 Females, Neendakara, 22.ii.1989; 1 Female, Attingal, 24.ii.1989; 1 Female, Chavara, 22.ii.1989; 1 Female, Vazhani, 7.ii.1989, Coll. P.M. Sureshan.

Remarks: This species closely resembles *T. nigra* (also described) but differs from it by the combination of characters given in the key. It also resembles *T. oryzae* Kamijo & Grissell in the nature of gastral petiole, propodeum etc., but differs in having pronotal collar not margined; temple length half of eye length; toruli placed only slightly above lower edge of eyes; club more than twice as long as wide; second anellus little longer than first, and mesoscutum width 2.3x length (in *oryzae* pronotal collar weakly but clearly margined, except at sides; temple length one quarter of eye length; club twice as long as wide; toruli placed distinctly above lower edge of eyes; second anellus much longer than first and mesoscutum twice as broad as long).

Trichomalopsis ovigastra sp. nov.
(Figs 19-25)

Female: Length 1.8-2.4 mm (Holotype 2.1 mm). Body dark brownish-green with metallic gloss. Antennae brown with scape paler in basal two thirds. Coxae concolorous with thorax, fore and mid coxae partly brownish; remainder of legs yellowish-brown. Tegulae brown; wings hyaline; veins pale brown.

Head (Figs 19, 20): Width 1.2x thorax; in dorsal view width 2x length and in front view width 1.3x height; temple length 0.5x eye length, rounded posteriorly; POL 1.4x OOL; eyes separated by 1.4x eye height; malar space length 0.7x eye length; clypeus striate; head otherwise moderately reticulate. Antennae (Fig. 21) inserted below middle of face; scape just shorter than eye (12: 11.5), reaching beyond median ocellus; pedicel plus flagellum length 0.9x head width.

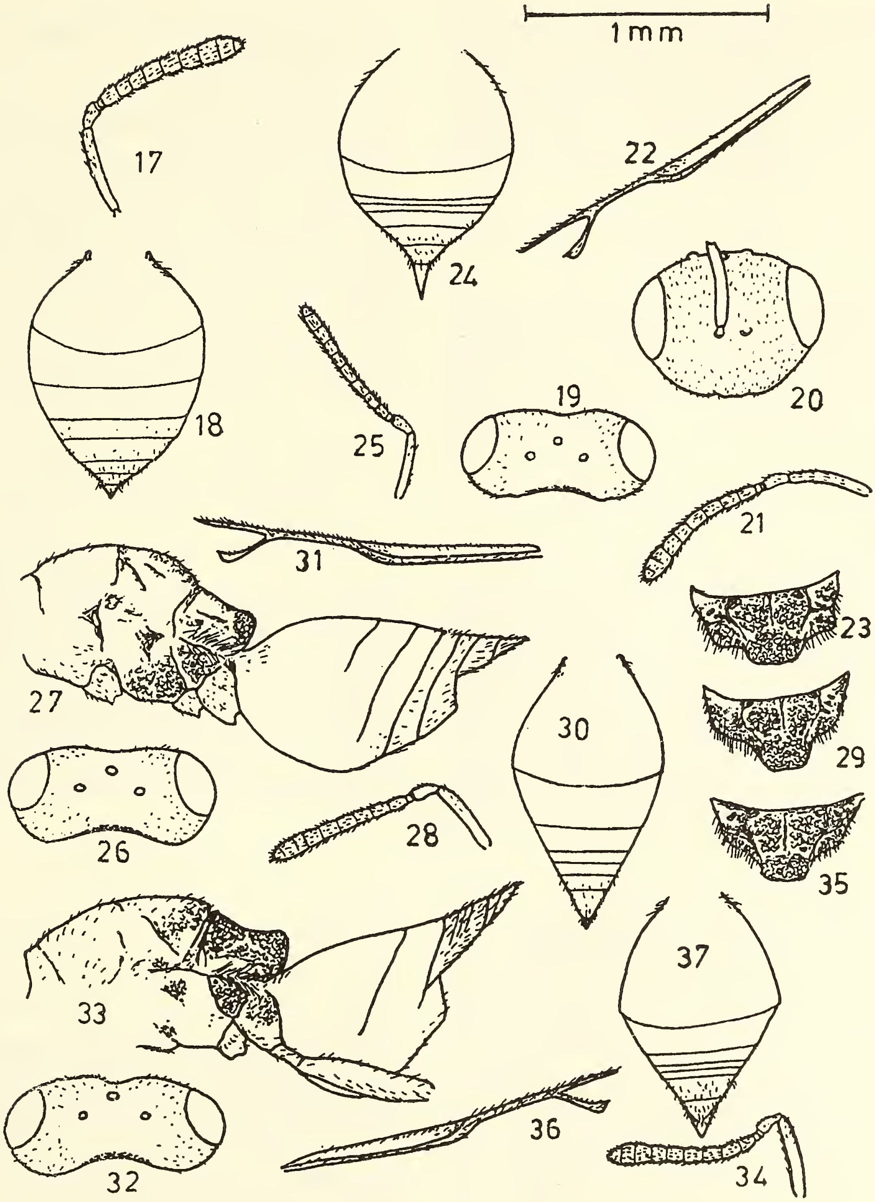
Thorax: Length 1.8x width, in profile thoracic dorsum evenly and weakly curved; pronotal collar anteriorly margined, posteriorly with smooth strip. Mesoscutum width 2.3x length, moderately reticulate. Scutellum wider than long (1.3x), slightly convex; frenal area slightly depressed. Propodeum (Fig. 23) medially 0.9x length of scutellum; median area broad, 1.3x as broad as median length, raised reticulate; median carina weak; nucha coarsely reticulate, occupying one third length of propodeum; plicae sharp; post spiracular sulcus with a transverse ridge; spiracles elongate oval; callus moderately hairy. Forewing (Fig. 22) length 2.5x width; basal cell with a few scattered hairs at distal end. Basal vein bare; costal cell with a single row of hairs on upper half, which is complete distally; MV 1.7x STV and as long as PMV. Relative lengths of SMV, MV, PMV and STV as 30 : 12.5 : 12.5 : 7.5.

Gaster (Fig. 24): Ovate, length 1.3x width (without ovipositor sheath); ovipositor sheaths strongly protruding.

Male (Fig. 25): Length 1.6 mm. Resembles female, but differs in antennae being slender and gaster shorter.

Material examined: Holotype: Female: India, Kerala, Vayalar, 27.ii.1989, Coll. P.M. Sureshan. **Allotype**: Male, data same as holotype. Paratypes: Kerala: 3 Females, data same as that of holotype; 1 Female, Elamathkavala (Shertallai), 27.ii.1989; 1 Female, Akalam (Trivandrum), 25.ii.1989; 1 Female, Attingal, 23.ii.1989, Coll. P.M. Sureshan.

Remarks: This species closely resembles *T. lasiocampae* (Graham) but differs from it in having pronotal collar regularly margined even at sides; median area of propodeum 1.3x as broad as long; median carina weak; PMV as long as MV, head and thorax bronze green, flagellum



Figs 17-18: *Trichomalopsis acarinata* sp. nov. Female: 17. Antenna, 18. Gaster in dorsal view; Figs 19-25: *Trichomalopsis ovigastra* sp. nov. Female: 19. Head in dorsal view, 20. Head in front view, 21. Antenna, 22. Forewing venation, 23. Propodeum, 24. Gaster in dorsal view, 25. Male antenna; Figs 26-31: *Trichomalopsis travancorensis* sp. nov. Female: 26. Head in dorsal view, 27. Thorax and gaster in profile, 28. Antenna, 29. Propodeum, 30. Gaster in dorsal view, 31. Forewing venation; Figs 32-37: *Trichomalopsis neelagastra* sp. nov. Female: 32. Head in dorsal view, 33. Thorax and gaster in profile, 34. Antenna, 35. Propodeum, 36. Forewing venation, 37. Gaster in dorsal view.

not stout (in *lasiocampae* collar irregularly margined except at sides, median area of propodeum 1.1-1.2x as broad as long and median carina distinct; PMV slightly shorter than MV; flagellum stout and thorax bright bluish-green).

Trichomalopsis travancorensis sp. nov. (Figs 26-31)

Female: Length 1.6-2.3 mm. (Holotype 2.3 mm). Head and thorax dark green with bronze-like gloss dorsally; gaster brown with slight bluish gloss dorsally on T1; Antennae brown with scape testaceous on two third part. Coxae concolorous with thorax; middle coxae brown; legs otherwise testaceous. Tegulae brown; wings hyaline; veins pale brown.

Head (Fig. 26): Width 1.14x thorax, in dorsal view width 2x length, in front view width 1.2x height; POL 1.4x OOL; temple length 0.7x eye length, slightly acuminate posteriorly; eyes separated by 1.4x their length; malar space length 0.6x eye length; clypeus with anterior margin weakly emarginate. Scape (Fig. 28) 0.9x eye length; pedicel plus flagellum length 0.9x head width; club a little longer than two preceding segments combined.

Thorax (Fig. 27): Length 1.6x width, moderately curved in profile; pronotal collar sharply margined almost throughout with smooth strip posteriorly. Mesoscutum width 2.2x length, moderately reticulate. Scutellum wider than long, less convex; frenal area distinct. Propodeum (Fig. 29) with median area 1.2x as broad as long; median carina weak; plicae not reaching tip of nucha; nucha moderately convex; callus moderately hairy; postspiracular sulcus with transverse ridge. Forewing (Fig. 31) with basal cell and vein bare; MV 1.9x STV and 1.3x PMV. Relative lengths of SMV, MV, PMV, and STV as 30 : 14 : 11 : 7.5.

Gaster (Fig. 27, 30): Ovate elongate; length 1.8x width; longer than thorax; petiole strongly transverse; T1 making up just less than half length (0.43x).

Male: Unknown.

Material examined: Holotype: India, Kerala, Female, Attingal, 23.ii.1989, Coll. P.M. Sureshan. Paratypes: Kerala: Calicut: 1 Female, Kazhakuttom, 25.ii.1989; 2 Females, Shertallai, 27.ii.1989; 1 Female, Vayalar, 27.ii.1989; 1 Female, data same as holotype; 2 Females, Kappil (Trivandrum), 26.ii.1989; 1 Female, Konni, 27.xi.1988; 1 Female, Aakalam (Trivandrum), 25.ii.1989; 1 Female, Ernakulam, 9.ii.1989; Coll. P.M. Sureshan; 1 Female, R.E.C. Calicut, 28.xi.1985, Coll. T.C. Narendran.

Remarks: This species resembles *T. dubius* (Ashmead) in head shape, nature of antenna and propodeum, but differs in having scutellum moderately convex; propodeum with median carina less sharp; gaster longer than thorax (in *dubius* scutellum flattened, propodeum with distinct sharp median carina and gaster about as long as thorax). Closely resembles *T. neelagastra* sp. nov. (also described) but differs from it in the combination of characters given in the key.

Trichomalopsis neelagastra sp. nov. (Figs 32-37)

Female: Length 2-2.4 mm. (Holotype 2.3 mm). Head and thorax dark bluish-green with bronze-like gloss; gaster dark bluish-green; T1 with strong metallic blue gloss. Antennae brown with paler scape. Coxae concolorous with thorax, remainder of legs testaceous. Tegulae testaceous; wings hyaline; veins pale brownish-yellow.

Head (Fig. 32): Width 1.2x that of thorax; in dorsal view width 2x length and in front view width 1.3x height; temple 0.7x eye length; POL 1.5x OOL; eyes separated by 1.5x their length; malar space 0.6x eye length; clypeus with anterior margin weakly emarginate; head moderately reticulate. Toruli placed above lower margin of eyes; scape (Fig. 34) as long as eye,

reaching level of vertex; combined length of pedicel and flagellum 0.9x head width.

Thorax (Fig. 33): Length 1.6x width; pronotal collar anteriorly margined throughout. Mesoscutum width 2.2x length. Scutellum less convex, wider than long, similarly sculptured as on mesoscutum; frenal area indicated. Propodeum (Fig. 35) with median area 1.2x as broad as long; median carina weak; plicae moderately strong; nucha convex; post spiracular sulcus with transverse ridge. Forewing (Fig. 36) with MV 1.8x STV and 1.5x PMV. Relative lengths of SMV, MV, PMV and STV as 41 : 15 : 10 : 8.5.

Gaster (Figs 33, 37): Ovate, length 1.7x width; as long as thorax; T1 occupying 0.54x length of gaster.

Male: Unknown.

Material examined: Holotype: India, Kerala, Female: Sreekariyam (Trivandrum), 25.ii.1989, Coll. P.M. Sureshan; Paratypes: Kerala: 1 Female, Kayamkulam, 21.ii.1989; 1 Female, Kappil (Trivandrum), 26.ii.1989; 1 Female, data same as holotype; 1 Female, Chavara, 22.ii.1989; 1 Female, Elamathkavala (Shertallai), 27.ii.1989; 1 Female, Ernakulam, 9.ii.1989; 1 Female, Tenjipalam (Malappuaram), 16.x.1988, Coll. P.M. Sureshan.

Remarks: This species generally resembles *T. caricicola* (Graham), but differs in having temple 0.7x eye length; mesoscutum width 2.2x length, moderately reticulate; MV about 1.8x STV and 1.5x PMV; T1 occupying 0.54 x length of gaster (in *caricicola* temple about one quarter the length of eye; mesoscutum about twice as broad as long and finely reticulate; MV about 1.5-1.6x STV and PMV subequal to MV and T1 occupying rather less than half length of gaster).

Acknowledgements

We are grateful to Dr. K. Kamijo, Bibai, Hokkaido, Japan for providing type material of the Oriental and Japanese species of *Trichomalopsis* and literature. P.M. Sureshan thanks the Director, Zoological Survey of India, Kolkata and the Officer-in-charge, Zoological Survey of India, Western Ghats Field Research Station, Calicut, Kerala for facilities and encouragement.

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SOME NEW CHIRONOMIDAE FROM SOUTH AND MIDDLE ANDAMAN ISLANDS, INDIA (DIPTERA: CHIRONOMIDAE)[1]

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(*With four text-figures*)

Key words: Diptera, Chironomidae, Andaman Islands, India

Little information is available on the Chironomidae of the Andaman and Nicobar Islands. Two new genera, namely *Indoaxarus* gen. nov., *Andamanus* gen. nov. and one new species *Lindebergia kadamtullaensis* sp. nov. are being described.

INTRODUCTION

Lindebergia Tuiskunen is a monotypic genus, based on a single male specimen, *L. bothnica* Tuiskunen. The taxonomic status of the genus was doubtful. Its independent taxonomic status is being established by cladistic analysis in this paper. A new species *L. kadamtullaensis* sp. nov. is also described. Two new genera and species namely *Andamanus manii* gen. nov., sp. nov. and *Indoaxarus santokhi* gen. nov., sp. nov. are also being described from Andaman and Nicobar Islands.

The structure and terminology of Saether (1980) has been followed.

Subfamily: Orthocladiinae
Genus *Andamanus* gen. nov.

Diagnosis: Habitat: Intertidal zone along the shoreline. Medium sized, pedicel rounded with two setal patches, antennal ratio 0.531, coronal suture incomplete, antepronotal lobes with dorsal notch, acrostichals absent, costa not extending beyond the tip of R_{4-5}. Claws curved, pulvilli absent, spermatheca single with neck, ramus weak and short, intergonocoxal membrane present, gonapophysis VIII is divided into dorsal ventral and median lobes. Cercus setose and triangular.

Andamanus manii gen. nov. sp. nov. (Figs 1a-e)

Description: **Female Imago**: Total body length 2.51 mm; wing length 1.88 mm.

Antenna: Scape poorly developed; pedicel rounded with two setal patches, anterior setal patch with 6-7 setae and posterior with 5-7 setae. Length/width of lst-4th flagellomeres: 0.136/ 0.033; 0.077/0.025; 0.077/0.022; 0.154/0.022 mm. First flagellomere larger than 2nd and 3rd, with two beaded structures, two whorls of setae, one on each. Second and third flagellomeres conical, each with a single whorl of 5-8 setae. Ultimate flagellomere beaded, broad based with a whorl of three setae on distal end. Antennal Ratio (AR) 0.531.

Head: Coronal suture incomplete, 0.109 mm long; temporal setae 20, frontal tubercle absent, eyes bare, bean-shaped, with weak dorsal extension. Length and width of clypeus 0.060 and 0.065 mm, clypeus bears 28 setae. Maxillary palps with five palpomeres, length/width: 0.026/ 0.021; 0.039/0.034; 0.104/0.030; 0.113/0.026; 0.217/ 0.017 mm. Tentorium tube, sieve tube, sieve pore present, cornua blunt, orifice rounded; labial lonchus elongated with rounded proximal end. (Fig. 1a)

Thorax: Antepronotal lobe reaching the projection of scutum, joining medially with a

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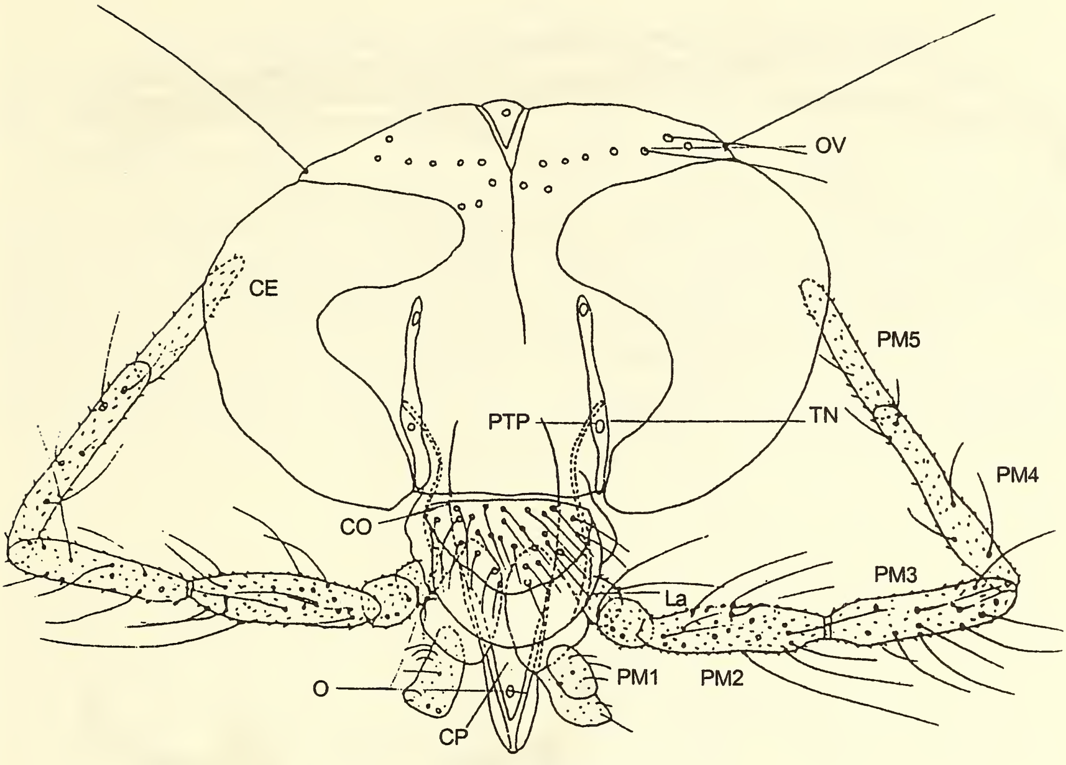

Fig. 1a: *Andamanus manii*: Head

narrow notch, bare. Dorsocentralis 18-20 in a single row. Acrostichals absent, scutellum with 11-13 scutellars.

Wings: Subcosta short, ending before R_1, R_1 ending distal to *r-m*, R_{2+3} very weak. Costa not extending beyond the tip of R_{4+5}. Squama not fringed (Fig. 1c).

Legs: Fore tibial apex with a blunt scale, spur absent, claws curved. Mid tibial apex with two combs, dorsal complete with a single spur, ventral with a peg-like spur. Length of spurs 0.040 and 0.018 mm. Hind tibial apex with a single comb including 0.063 mm long spur. Pulvilli and empodium absent.

Female Genitalia: Spermatheca single, elongated, with neck, spermathecal duct opens independently into spermathecal eminence. Notum

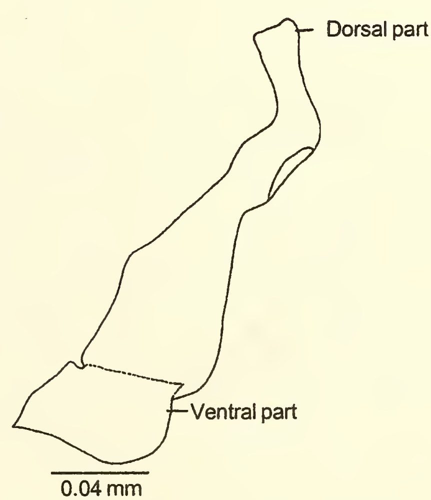

Fig. 1b: *Andamanus manii*: Anteropronotum lobe

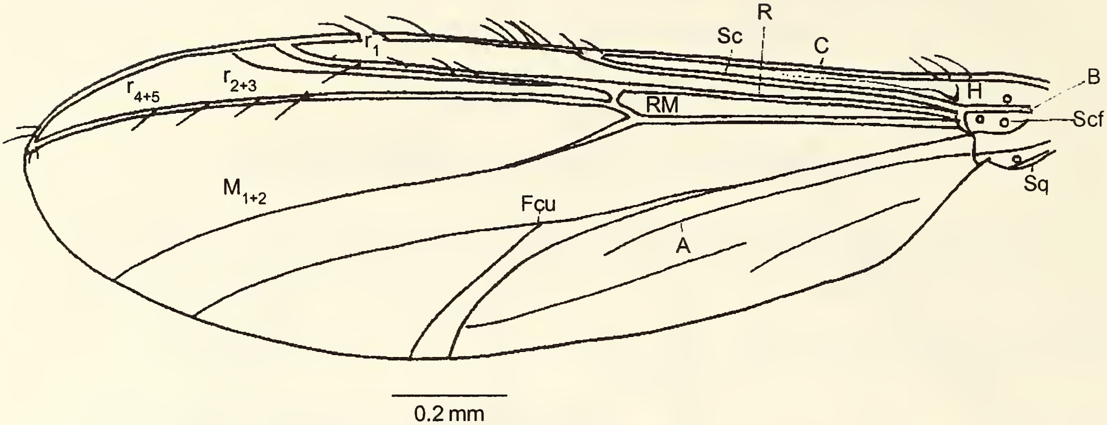

Fig. 1c: *Andamanus manii*: Wing

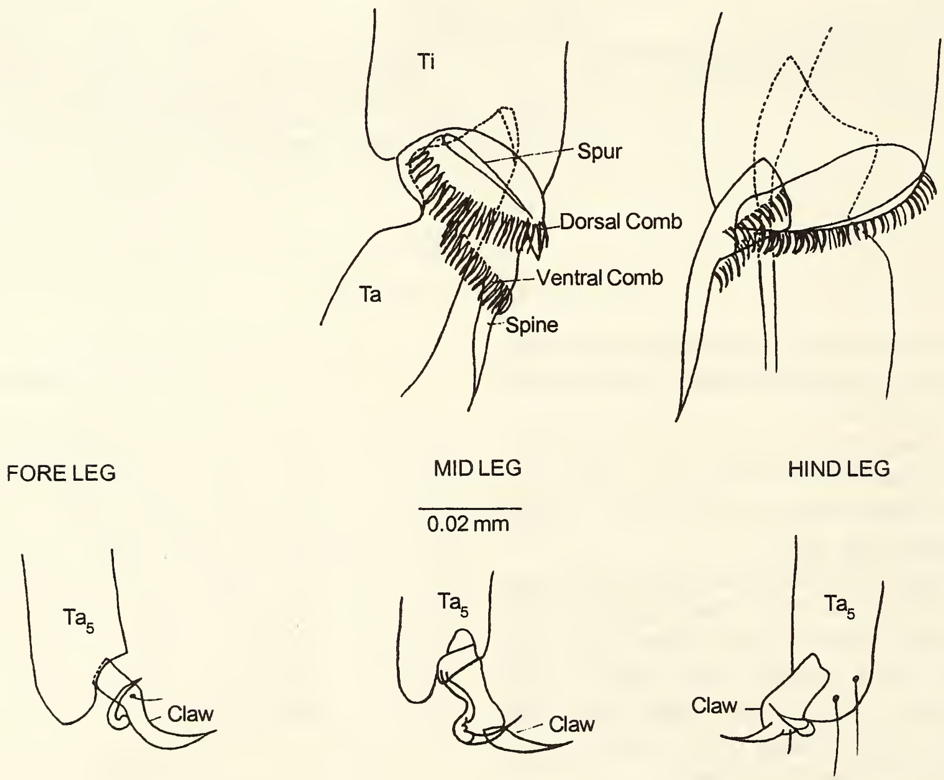

Fig. 1d: *Andamanus manii:* ♀legs (First row: tibial apex, second row: fifth tarsal)

TABLE 1
MEASUREMENTS OF LEGS (IN MM) AND LEG RATIO (LR) OF *ANDAMANUS MANII*

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	0.872	0.631	1.095	0.5568	0.445	0.363	0.159	1.735
P_2	1.063	0.963	0.681	0.3891	0.340	0.200	0.113	0.707
P_3	0.927	0.877	0.436	0.263	0.204	0.136	0.090	0.497

elongated, ramus weak and short. Labia elongated with microtrichia. Postgenital plate broad, rounded. Intergonocoxal connective membrane present. Gonapophysis VIII setose divided into dorsal, ventral and median lobes. Gonocoxal apodeme extending to proximal end of coxosternapodeme. Cercus setose and triangular (Fig. 1e).

Type locality: Mayabunder, Middle Andaman; Andaman and Nicobar Is.; India.

Etymology: Named after Prof. M.S. Mani, the founder of School of Entomology.

Holotype: 1♀ Mayabunder, Middle Andaman, 21.xii.1983, Coll. G. Maheshwari. Deposited in the collection of School of

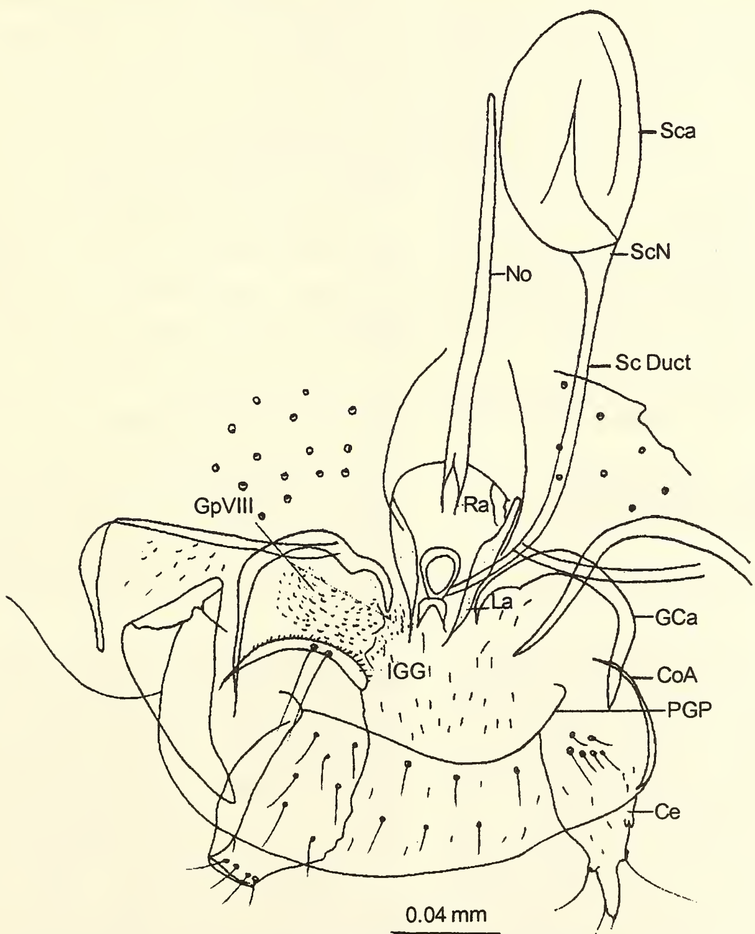

Fig. 1e: *Andamanus manii*: ♀ Genitalia

Entomology, St. John's College, Agra; India, (Regn. No. Ch. 21).

Paratype: Regn. No. Ch. 21a, one ♀, same data as holotype.

Systematics: The new genus *Andamanus* resembles the genus *Halocladius* Hirvenoja from the coastal brackish waters of the Holarctic Region. It also has certain affinities with *Cricotopus* v.d. Wulp and *Paracladius* Hirvenoja. *Halocladius*, *Cricotopus* and *Paracladius* can be distinguished from *Andamanus* gen. nov. by the presence of a decumbent dorsocentralis. *Paracladius* can be separated by prealars not extending anterior to level of median anepisternum II and bare mediolongitudinal area of tergite. *Cricotopus* and *Halocladius* can also be distinguished from *Andamanus* gen. nov., by hairy eyes. Female of *Andamanus* gen. nov. can be identified by a combination of characters: scape poorly developed, coronal suture incomplete, frontal tubercles absent, eyes bare, sieve pores present, antepronotal fused dorsally, subcosta short and ending before R_1, pulvilli and empodium absent, spermatheca single, elongated with spermathecal neck.

Remarks: Adults were found gyrating on the water surface in the intertidal zone.

Subfamily: Orthocladiinae
Genus ***Lindebergia*** Tuiskunen

Lindebergia Tuiskunen, *Ann. ent. Fenn.* 50:121

Diagnosis: *Lindebergia* Tuiskunen is a monotypic genus known only for *L. bothnica*. A single adult male was collected from the northern shore of the Gulf of Bothnia, Finland. It is characterised by 13 flagellomeres, sensilla chaetica on flagellomere 2, 3 and 13. Eyes bare without dorsomedial extension. Palp without sensilla clavata. Squamae bare. Pulvilli small. Pars ventralis present, gonostylus narrow without crista dorsalis, broad megaseta present.

Lindebergia kadamtullaensis sp. nov.
(Figs 2a-f)

Description: **Male Imago**: Body length 2.39 mm, wing length 1.397 mm, wing width 0.397 mm, body length : wing length is 1.71:1.0.

Antenna: Scape well developed and bare, pedicel covered with microsetae, flagellum with 13 flagellomeres, a median groove extends between 3rd and ultimate flagellomeres, distribution of setae from 1st to ultimate flagellomeres is 2-4, 9-11, 10-11, 10-12, 11-13, 8-10, 10-12, 11-13, 7-10, 10-11, 9-11, 10-12 and 75-85 respectively. Length and width of pedicel 0.88 and 0.114 mm. Length and width of flagellomeres lst-13th (in mm): 0.047, 0.025; 0.018, 0.025; 0.025, 0.025; 0.025, 0.022; 0.025, 0.023; 0.029, 0.020; 0.031, 0.018; 0.033, 0.018; 0.035, 0.018; 0.036, 0.016; 0.036, 0.014; 0.036, 0.016; 0.321, 0.016. Antennal ratio (AR) 0.853.

Head: Coronal suture complete, 0.166 mm long, frontal tubercle present, temporal setae 5 (2 frontals, 3 post orbitals). Eyes bare without dorsal extension. Length and width of clypeus 0.051 and 0.099 mm respectively, with 18-22 setae. Maxillary palp with five palpomeres, length and width of palpomeres: 0.018, 0.014; 0.033, 0.020; 0.073, 0.018; 0.121, 0.16; 0.11, 0.016 mm respectively. Tentorium arm tubular, anterior tentorium pit and sieve pores absent; stipes narrow, cornua blunt and curved, orifice not seen, labial lonchus elongated and porous (Fig. 2a).

Thorax: Antepronotal lobes meeting dorsally, antepronotal 3-5; scutal tubercle absent, acrostichals absent; dorsocentralis in two rows, 8-12 in each row. Scopula thoracalis present; prealars not seen, humerals 2-4; scutellars in two rows, 5-7 in each row. Preepisternals 7-9; anepisternals 2-3; median anepisternal II absent.

Wings: Arculus bare, sensilla campaniformia present, alula poorly developed. Costa extending well beyond the tip of R_{4+5}; subcosta short, reaching the middle of R_{2+3}; R_1

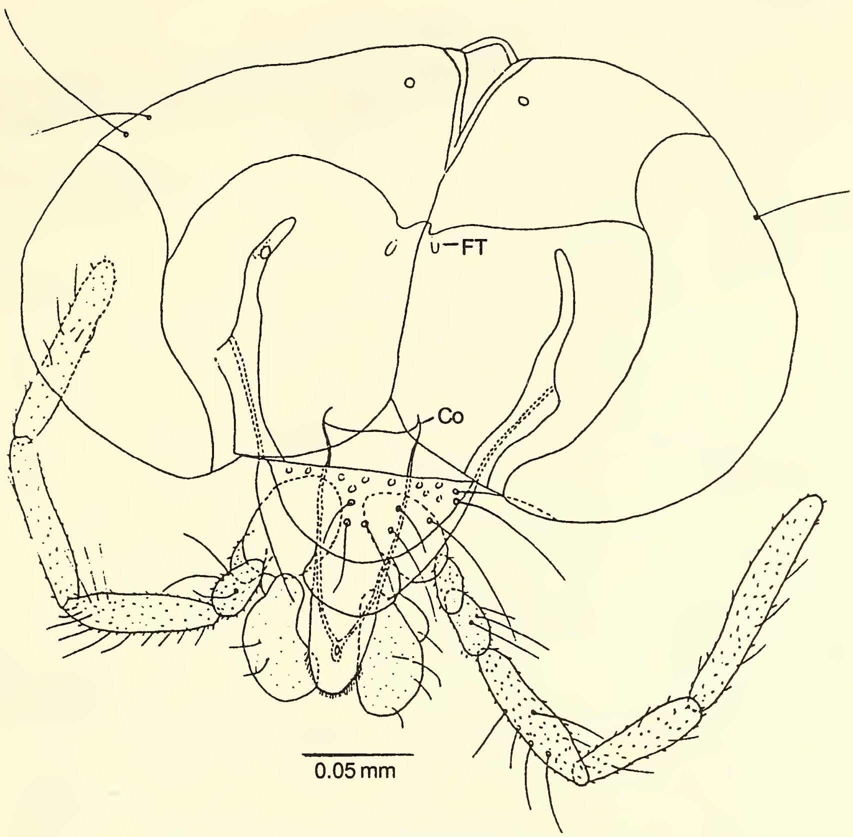

Fig. 2a: *Lindebergia kadamtullaensis*: Head

proximal to Cu_1; R_{2+3} terminates near R_{4+5}; R_{4+5} terminates slightly distal to Cu_1; *r-m* proximal to cubital fork; Cu_2 curved sharply (Fig. 2b).

Legs: Fore femur with a scale at distal inner margin; tibia with a single spur (0.054 mm long), comb absent. Empodium absent, claws slightly curved. Middle tibia with two spurs, outer spur 0.023 mm and inner spur 0.019 mm long. Pulvilli, arolium and empodium absent. Hind tibial apex with a row of 12-15 strong setae, each tibia with two spurs, inner 0.020 mm and outer 0.054 mm long (Fig. 2c).

Male genitalia: Anterior end of abdominal segment VIII strongly narrow, posterior end broad, typically triangular. Anal tergal band V-type, reaching the base of aedeagus. Superior volsella almost tongue shaped, setose. Pars ventralis very well developed with 6-8 marginal setae. Anal point broad, reaching the middle of gonocoxite. Gonostylus short, folded anteriorly and of peculiar shape (distal end broad with crista dorsalis), distal end rounded and broad. Crista dorsalis and megaseta present; megaseta rod shaped. Paraphallic ratio 2.62.

Female Imago: Total body length 2.58 mm, Head length 0.173 mm.

Antenna: Scape well developed, pedicel covered with microtrichia. Flagellum with five flagellomeres, each bearing 3, 4, 6, 5, 8 setae respectively.

Head: Coronal suture complete, 0.159 mm long. Frontal tubercle present, temporal setae

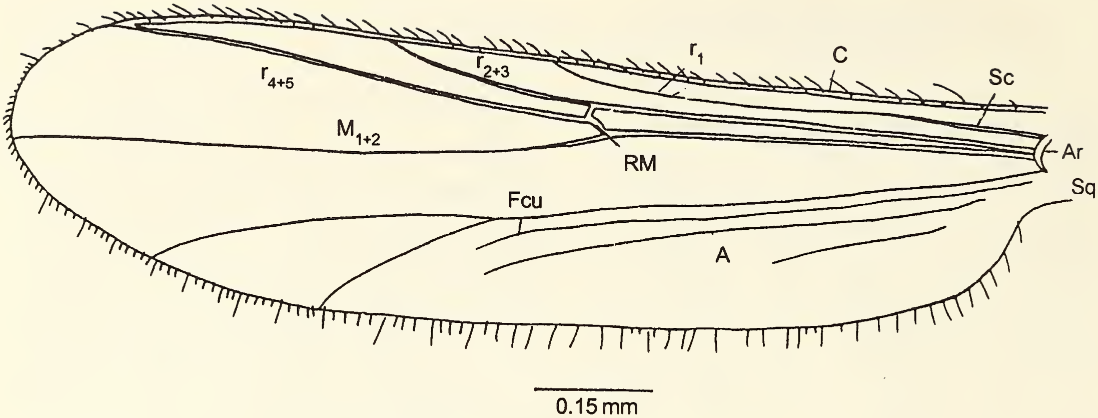

Fig. 2b: *Lindebergia kadamtullaensis*: Wing

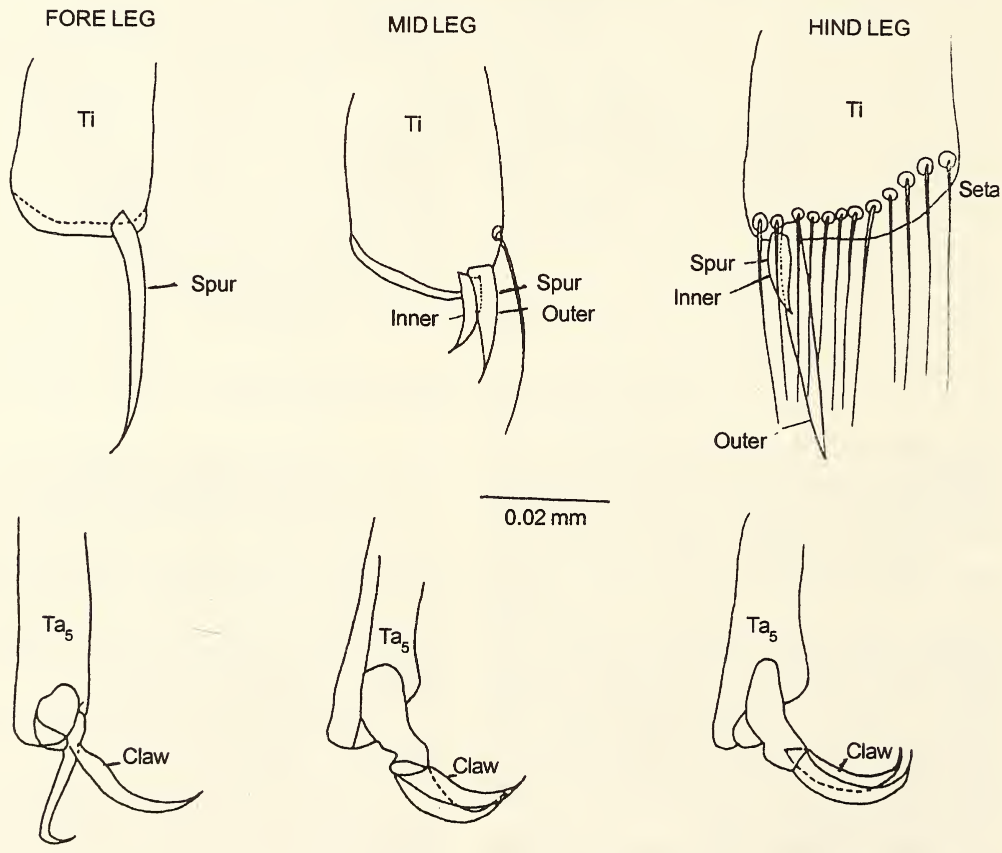

Fig. 2c: *Lindebergia kadamtullaensis*: ♂ Legs (First row: tibial apex, Second row: fifth tarsal)

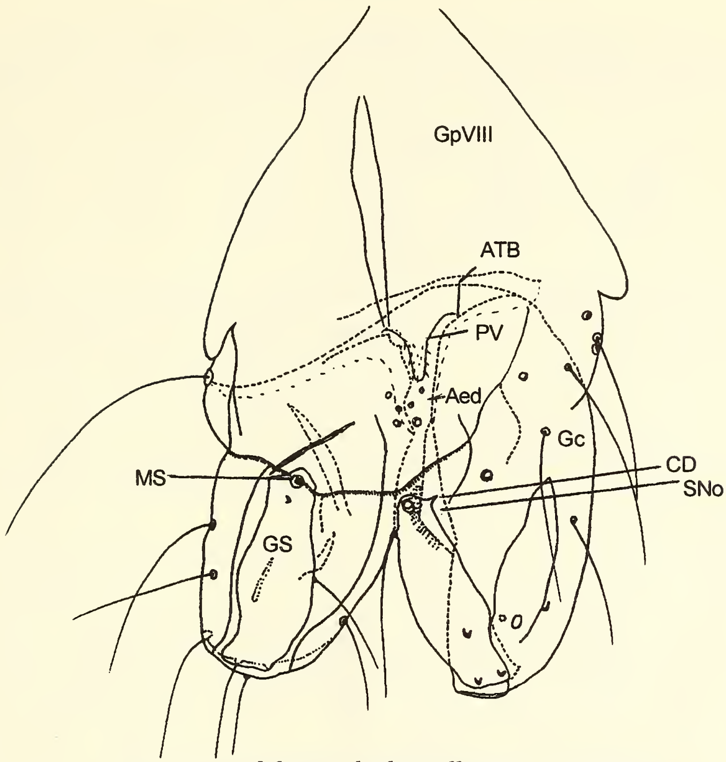

Fig. 2d: *Lindebergia kadamtullaensis*: ♂ Genitalia

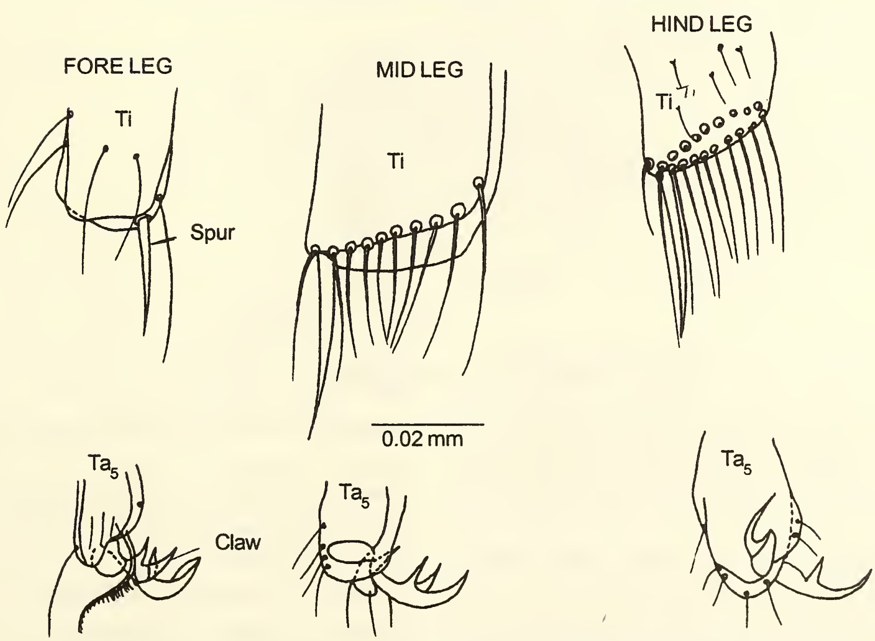

Fig. 2e: *Lindebergia kadamtullaensis*: ♀ Legs (First row: tibial apex, Second row: fifth tarsal)

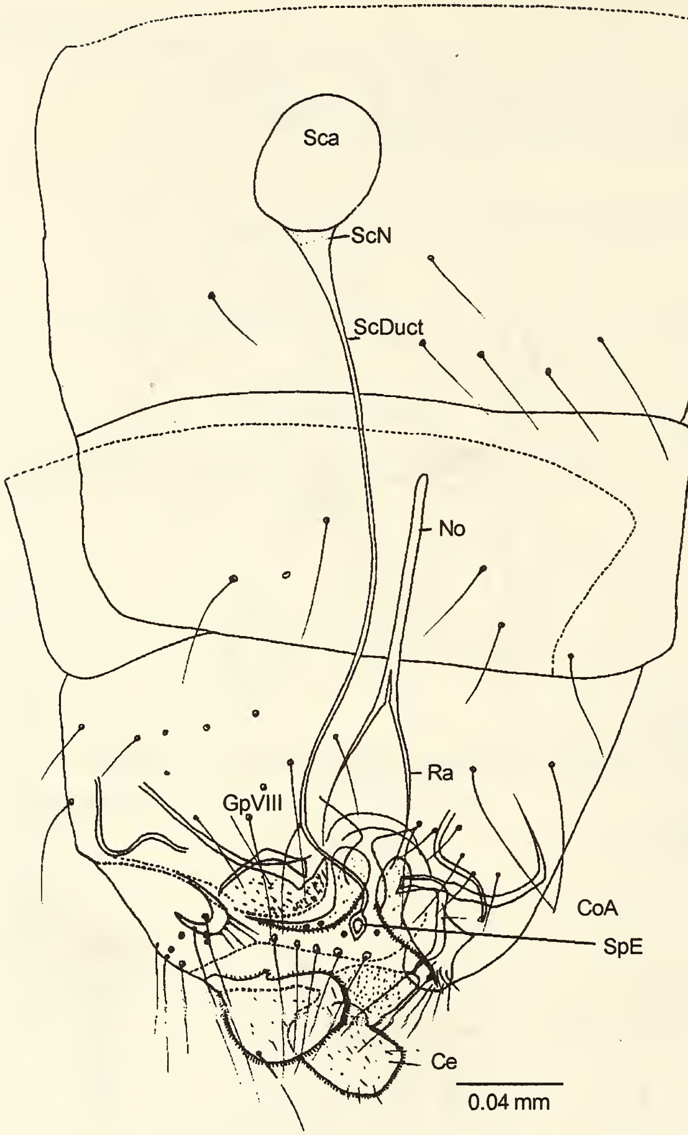

Fig. 2f: *Lindebergia kadamtullaensis*: ♀ Genitalia

4-6; eyes bare without dorsal extension. Maxillary palps five. Tentorial arm tubular, sieve pore absent, stipes narrow, cornua blunt and curved.

Thorax, Wing and Legs: Same as male.

Female genitalia: Spermatheca single, situated in abdominal segment VII, almost oval, with a distinct neck; spermathecal duct straight. Notum very well developed. Ramus forked at anterior margin of tergite IX, extending posteriorly to labia. Coxosternapodeme S-shaped. Labia comma shaped, covered with microtrichia. Spermathecal duct opens into spermathecal eminence without any modification. Gonocoxal apodeme straight. Gonapophyis VIII well developed, divided into dorsal and ventral lobes,

TABLE 2
MEASUREMENTS OF LEGS (IN MM) AND LEG RATIO (LR) OF *LINDEBERGIA KADAMTULLAENSIS*

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	0.5527	0.713	0.363	0.218	0.150	0.081	0.072	0.51
P_2	0.540	0.577	0.277	0.140	0.104	0.063	0.065	0.48
P_3	0.572	0.690	0.395	0.195	0.159	0.077	0.075	0.57

setose. Gonocoxite IX lobe shaped, covered with microtrichia. Postgenital plate triangular, bears setae. Gonostylus IX not visible, cercus flap-shaped, covered with microtrichia and macrotrichia.

Type locality: Kadamtulla seashore, Middle Andaman; Andaman and Nicobar Is.; India.

Etymology: Named after the site of collection, Kadamtulla.

Holotype: 1 ♀ Kadamtulla, Andaman and Nicobar Is., Coll. G. Maheshwari; deposited in the collection of School of Entomology, St. John's College, Agra, India. Regn. No. Ch. 22.

Paratypes: 1♂, 3 ♀♀, (Regn. No. Ch. 22a, Ch 22b, Ch. 22c and Ch. 22d respectively) data same as holotype.

Systematics: The validity of the genus was not certain so far (Tuiskunen 1984). By describing one more species, *Lindebergia kadamtullaensis*, from the shore of Kadamtulla, Middle Andaman, from 2 male and 3 female specimens, the genus can be given validity. *L. kadamtullaensis* sp. nov. is closely related to *L. bothnica*, but can be distinguished by straight broad gonostylus with crista dorsalis and rod-shaped megaseta, pars ventralis long, broad anal point and strong triangular abdominal segment VIII. Female genitalia are described in detail.

Ecology: All specimens were collected from the rocky shoreline near Kadamtulla guest house, using Diptera net having a mesh size of 50-80μ. One female was collected using an aspirator. Immature stages of the species are not known.

Subfamily: Chironominae
Tribe: Chironomini
Genus ***Indoaxarus*** gen. nov.

Diagnosis: Habitat: Coastal ponds and lakes. Medium sized, scape poorly developed, eleven flagellomeres, male antenna poorly plumose, frontal tubercle absent, antepronotal lobe bare and fused medially. Squamae bare, sensilla campaniformia present, *r-m* oblique, cubital fork distal to *r-m*. Foretibial apex with blunt scale, empodium serrated; middle tibial apex with two combs, each with movable spine. Anal tergal bands V-type, phallapodeme subulate, anal point T-shaped, strongly curved ventrally, superior volsella S-type, inferior volsella bearing falciform setae, median volsella lobe-like. Gonostylus directed posteriorly, crista dorsalis and megaseta absent.

Etymology: Since the material was collected from India and bears close affinities to *Axarus*, the genus has been named *Indoaxarus*.

Indoaxarus santokhi sp. nov.
(Figs 3a-d)

Description: **Male Imago**: Medium sized, total length 3.017 mm, wing length 2.183 mm, wing length: wing width 4.56: 3.61.

Antenna: Scape poorly developed; flagellum with 11 flagellomeres; flagellum poorly plumose; 2nd to 10th flagellomeres almost equal, distribution of setae on flagellomeres, 5-6, 8-9, 9-10, 9-11, 9-10, 10-11, 10-11, 10-11, 1-9, 9-11, 3-5; ultimate flagellomere with 40-50 bristles. Last flagellomere longer than combined length

of rest of flagellomeres. A median groove present from first to last flagellomere. Length and width of pedicel 0.09-0.13 mm respectively. Length and width of flagellomeres, 1st - 11th: 0.088, 0.033; 0.029, 0.033; 0.025, 0.033; 0.033, 0.029; 0.025, 0.029; 0.025, 0.029; 0.029, 0.029; 0.02, 0.029; 0.025, 0.025; 0.025, 0.025; 0.564, 0.025 respectively. Antennal ratio (AR) 1.714.

Head: Coronal suture complete, 0.234 mm long; temporal setae 14-16 (including post orbitals), frontal tubercle absent; eyes bare; clypeus with 14 clypeals, length/width 0.065, 0.082 mm respectively. Maxillary palps with five palpomeres, average length/width of palpomeres 0.032/0.21; 0.037/0.26; 0.104/0.026; 0.084/0.021; 0.151/0.016 mm respectively. Tentorium arm tube-like, posterior tentorial pit distal, sieve pore absent, anterior tentorial pit well developed, stipe tubular, length and width 0.087, 0.021 mm respectively. Cornua blunt, orifice oval, labial lonchus elongated with rounded proximal end. (Fig. 3a)

Thorax: Antepronotal lobe reaching the projection of scutum, meeting medially, bare; scutal tubercle present, bare; acrostichals four; dorsocentralis eight in a single row; humeral one;

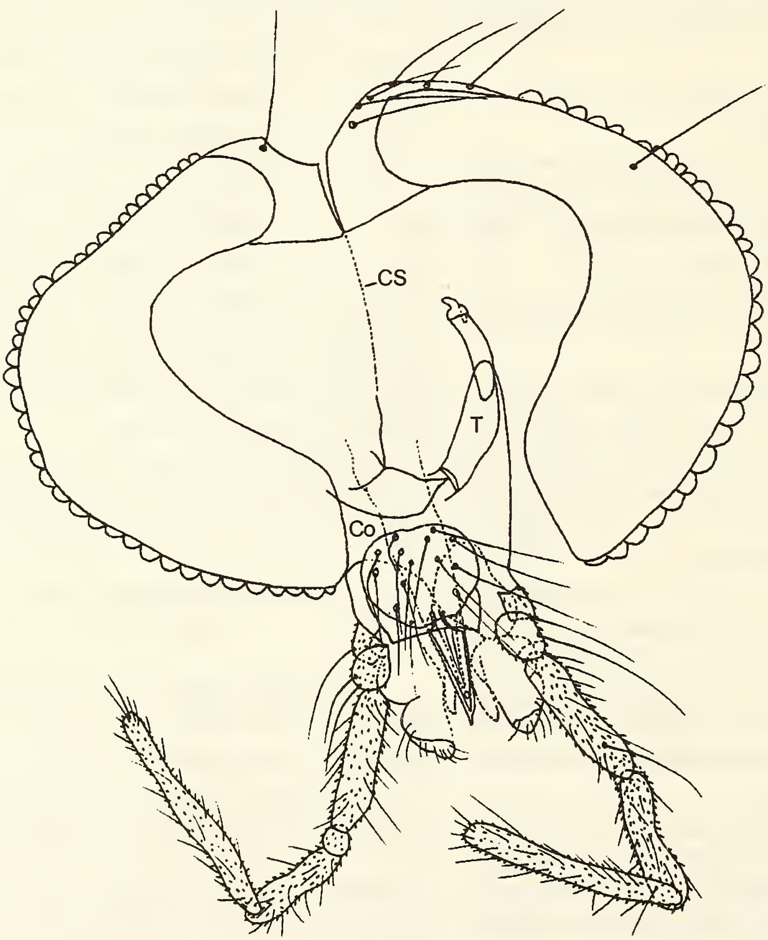

Fig. 3a: *Indoaxarus santokhi*: Head

prealars two, scutellars 7-9, preepisternals 6-8; anepisternal suture complete; anepisternal 1-3.

Wing: Squamae bare, tegula small and triangular with a single seta; brachiolum with microtrichia and two setae; humeral plate square with microtrichia; scopula alaris covered with dense macrotrichia; axillary sclerites (III) with 2-3 setae, venarum ratio (VR) 0.408, sensilla campaniformia present; costa extends up to tip of R_{4+5}; subcosta terminates distal to r-m; radius with 12-14 setae, R_1 and R_{2+3} bare, R_{2+3} terminates near R_1, R_{4+5} straight, making a round with costa, R_{4+5} bare; *r-m*, oblique, media straight, ends distal to Cu_1, *m-cu* absent, cubital fork distal to *r-m*, Cu_2 straight. (Fig. 3b)

Legs: Fore leg elongated, tibial apex with a blunt scale, first tarsal longer than tibia; fifth tarsal with a pair of highly curved claws. Empodium serrated and elongated; middle tibial apex with two combs, each with movable spine; dorsal scale present. Hind tibial apex bears dorsal and ventral combs (30-34 and 14-17 setae respectively), each containing a spur; ventro-lateral margin with pectinate scale, with two tiers of serrated structures (Fig. 3c).

Male Genitalia: Anal tergal bands V-type, reaching the base of anal point, lateral sternapodeme slightly curved, transverse sternapodeme broad; phallapodeme subulate, coxapodeme straight, anal point broad distally, bare; T-shaped, very strongly curved ventrally, aedeagal setal patch with 11-16 setae; superior volsella S-type, bare, reaching up to 5/6th length of inferior volsella. Inferior volsella elongated lobe-shaped, bearing falciform setae. Median volsella broad, rounded, lobe-like, bearing microtrichia, reaching middle of inferior volsella. Gonocoxite with broad base, triangular in shape; gonostylus directed posteriorly, narrow base, elongated, pointed distally, distal inner margin with 13-17 subulate setae. Crista dorsalis and megaseta absent. Paraphallic ratio 0.32 (Fig. 3d).

Type locality: Port Blair, South Andaman; Andaman and Nicobar Is.; India.

Etymology: Named after Dr. Santokh Singh, one of the pioneers of high altitude entomology.

Holotype: ♂ labelled Port Blair, Pond near Fire Brigade Station, 29.xii.1983, Coll. G. Maheshwari. Deposited in the collection of School of Entomology. St. John's College, Agra, India (Regn. No. Ch. 23).

Paratypes: 4 ♂♂, (Regn. No. Ch. 23a-d) data same as holotype.

Systematics: *Indoaxarus* gen. nov. resembles *Axarus* Roback and *Xenochironomus* Kieffer. *Xenochironomus* can be distinguished by antepronotal lobes dorsally separated, scutum

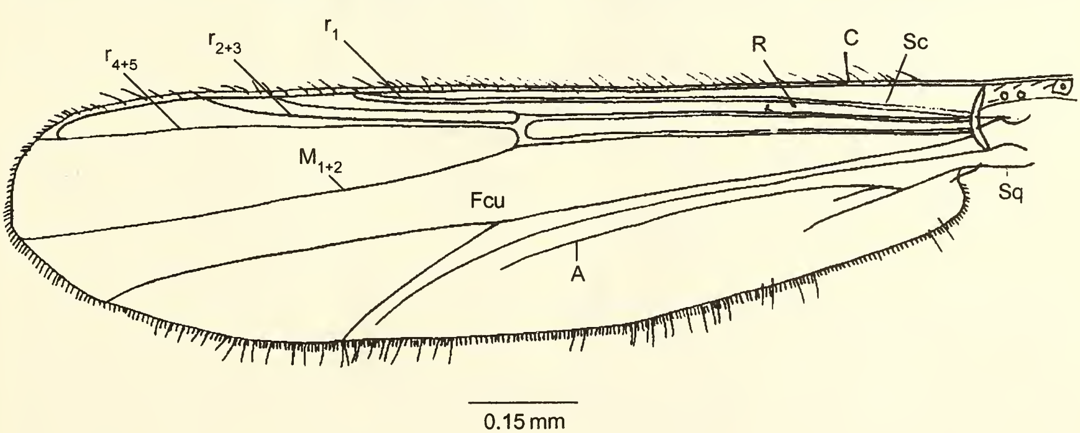

Fig. 3b: *Indoaxarus santokhi*: Wing

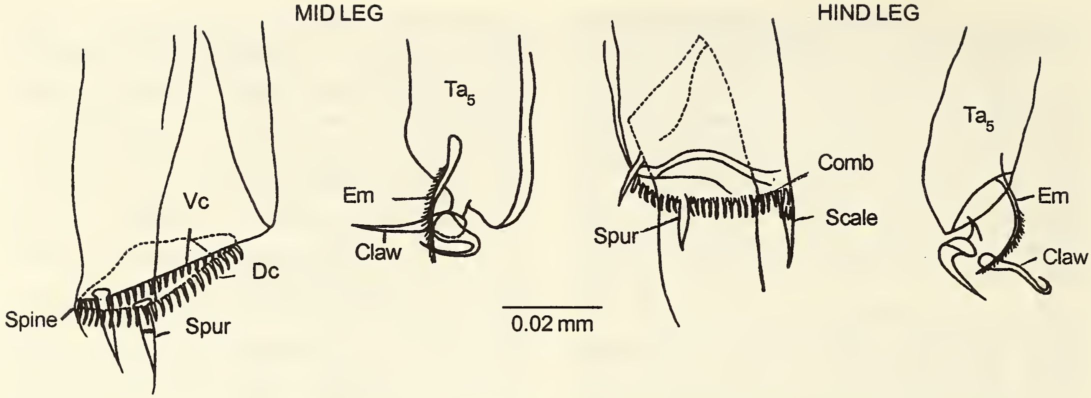

Fig. 3c: *Indoaxarus santokhi*: ♂ Legs (First row: tibial apex, Second row: fifth tarsal)

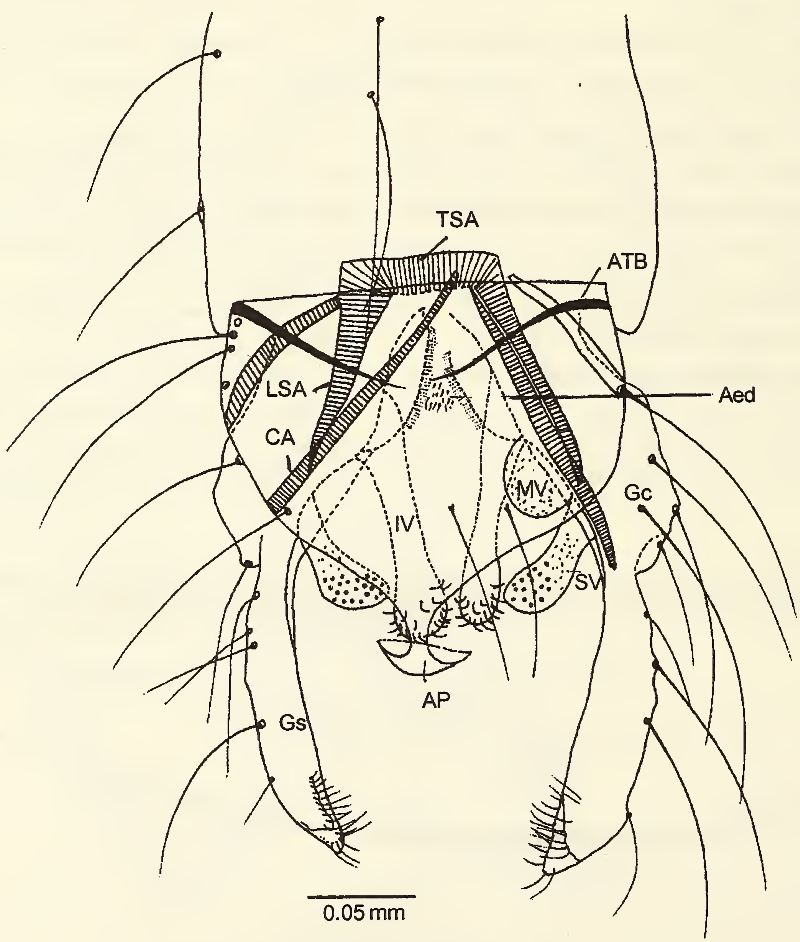

Fig. 3d: *Indoaxarus santokhi*: ♂ Genitalia

TABLE 3
MEASUREMENTS OF LEGS (IN MM) AND LEG RATIO (LR) OF *INDOAXARUS SANTOKHI*

	Fe	Ti	Ta_1	Ta_2	Ta_3	Ta_4	Ta_5	LR
P_1	0.636	0.463	0.831	0.418	0.340	0.236	0.118	1.79
P_2	0.640	0.590	0.309	0.159	0.068	0.127	0.063	0.52
P_3	0.613	0.531	0.295	0.304	0.127	0.063	0.055	0.55

tubercle absent, squama fringed, pulvilli present, superior volsella very short, median volsella absent, gonostylus medially broadened. Genus *Axarus* can be diagnosed by antepronotal lobes dorsally wide apart, scutum tubercle absent, anal lobe of wing absent, squama not fringed, pulvilli present, superior volsella flap-like, with forked and expanded microtrichia, median volsella absent. As apparent from the above discussion, the genus *Indoaxarus* has its own peculiarities and independent status.

Ecology and distribution: *Indoaxarus* was collected from a coastal pond in Port Blair (South Andaman Islands), while *Axarus* inhabits littoral and sublittoral soft sediment of rivers and lakes. *Xenochironomus* are obligate miners of fresh water sponges.

Phylogenetic considerations: In order to determine the validity of a newly proposed taxon above the species level, a cladistic analysis should be done. We have studied the phylogenetic position of the new genus within Family Chironomidae. The polarity of the characters have been determined by the following Out Group Comparison Method (Wiley 1981).

Previous investigations have not explicitly discussed the relationship of *Lindebergia* with the other Chironomidae. The genus is monobasic, in Subfamily Orthocladiinae, pars ventralis is present only in *Lindebergia* and some *Limnophyes*. This shows that the character is synapomorphic. The present analysis evaluated 12 characters and eight taxa, including a generalized outgroup based largely on the Simulidae and Ceratopogonidae. Most multistate characters such as 1, 5 and 6 are coded as additive, as outgroup comparison permitted

TABLE 4
CHARACTERS AND ALTERNATE STATES USED IN CLADISTIC ANALYSIS

1.	Antenna	0.	♂ antenna plumose
		1.	♂ antenna poorly plumose
		2.	♂ antenna pilose
2.	Coronal suture	0.	Coronal suture complete
		1.	Coronal suture incomplete
		2.	Coronal suture very poorly developed.
3.	Median volsella	0.	Median volsella absent
		1.	Median volsella present
4.	Eyes	0.	Eyes bare
		1.	Eyes hairy
5.	Maxillary palp	0.	Maxillary palp with 4 palpomeres
		1.	Maxillary palp with 5 palpomeres
		2.	Maxillary palp with 3 palpomeres
6.	Antepronotal lobes	0.	Antepronotal lobes fused medially
		1.	Antepronotal lobes with median notch
		2.	Antepronotal lobes separated
7.	Supra-alars	0.	Supra-alars absent.
		1.	Supra-alars present
8.	Squamae	0.	Squama not fringed
		1.	Squama fringed
9.	Pulvilli	0.	Pulvilli absent
		1.	Pulvilli present
10.	Post genital plate	0.	Weakly developed
		1.	Well developed
11.	Spermathecae	0.	Without microtrichia
		1.	With microtrichia
12.	Spermathecal duct	0.	Spermathecal ducts without bulb before common opening.
		1.	Spermathecal ducts with bulb before common opening.

(0 = plesiomorphic; 1, 2 apomorphic)

logical arrangement in linear transformation series. Homoplasy is exhibited by characters 7, 8, 9. In case of *Indoaxarus* and *Axarus*, symplesiomorphy is shown by characters 4, 5 and 7. Autapomorphies, certain characters of male genitalia, such as volsella, provide no information

TABLE 5
MATRIX OF CHARACTERS AND ALTERNATE STATES USED IN THE CLADISTIC ANALYSIS (M=MALE, F=FEMALE, ?=UNKNOWN)

Taxon/Characters	1	2	3	4	5	6	7	8	9	10	11	12
Out group	0	0	0	0	0	0	0	0	0	0	0	0
Indoaxarus	1	0	1	0	1	0	1	0	0	?	?	?
Axarus	0	?	0	0	1	2	1	1	1	?	?	?
Xenochironomus	0	0	0	0	1	2	1	1	1	1	1	0
Andamanus	0	1	?	0	1	0	1	0	0	1	0	0
Halocladius	0	0	0	1	2	1	1	1	0	1	0	1
Cricotopus	0-2	0-1	0	1	0	1	0	1	0-1	0-1	1	1
Semaphoront	M	M+F	M	M+F	M+F	M+F	M+F	M+F	M+F	F	F	F

about relationship and were therefore excluded from the analysis. Character analysis resulted in a single tree with a few steps (Fig. 4).

Abbreviations used: Ar = Arolium, PM1-PM5 = Palpomeres 1-5, O = Orfice, La = Labia, PTP = Post tentorial pit, TN = Tentorium, OV = Outer verticals, CP = Cibarial pump, B = Brachiolum, Scf = Sensilla campaniformia, CO = cornua, Sq = Squama, A = Anal, Ti = Tibia, Ta1-Ta5 = Tarsal 1-5, Sca = Spermatheca, ScN = Spermathecal Neck, Sc Duct = Spermathecal duct, No = Notum, GCa = Gonocoxapodeme, Coa = Coxasternapodeme, PGP = Post genital plate, CE = Cercus, Gp VIII = Gonapophysis VIII, Ra = Ramus, SPE = Spermathecal eminence, FT = Frontal tubercle, Aed = Aedeagus, ATB = Anal Tergal band, PV = Pars Ventralis, SVo = Superior volsella, MS = Mega Seta, CD = Crista dorsalis, CS = Coronal suture, T = Tentorium, VC = Ventral Comb, DC = Dorsal Comb, Em = Empodium, AP = Anal Point, MVo = Median volsella, IVo = Inferior volsella, TSA = Transverse sternapodeme, LSA = Lateral sternapodeme, R = radius, C = Costa, Sc = Subcosta, RM = Radiomedian.

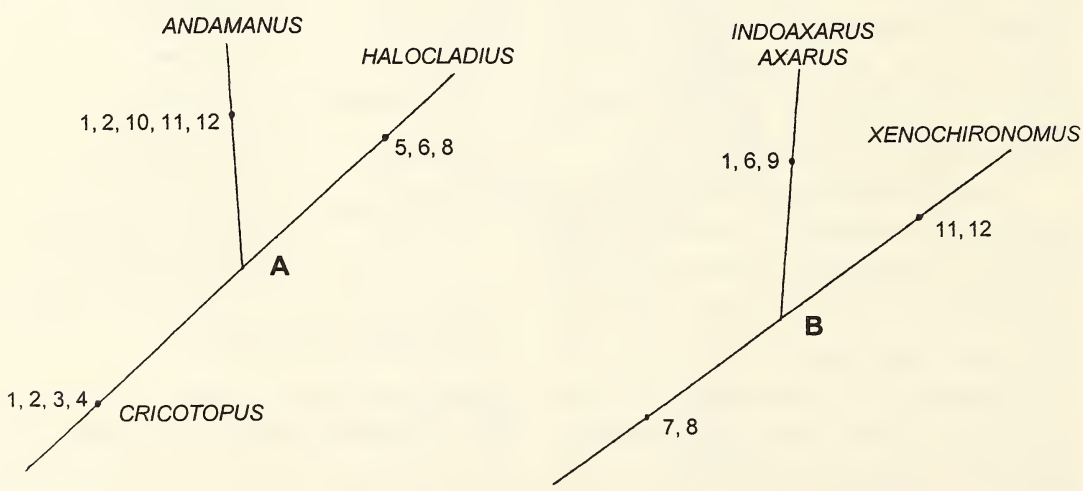

Fig. 4: Hypothesized phylogenetic relationship of new genera, *Indoaxarus* and *Andamanus* with other Chironomidae

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■ ■ ■

A NEW SPECIES OF MOTH UNDER GENUS *LEMYRA* (ARCTIINAE: ARCTIIDAE : LEPIDOPTERA)[1]

AMRITPAL S. KALEKA[2]

(*With eight text-figures*)

Key words: *Lemyra*, *L. stigmata*, *L. wernerthomasi*, *L. walkeri* sp. nov.

A new species *walkeri* of genus *Lemyra* Walker (Family Arctiidae, Lepidoptera) has been described and illustrated. It is closely allied to *Lemyra stigmata* Moore.

INTRODUCTION

The genus *Lemyra* Walker was proposed as a monotypic genus by Walker in 1856 with the type species *extensa* from Sulawesi (Celebes). Hampson (1894, 1901) has not included this genus in his publications. The type species of the genus has been studied in detail by Holloway (1988). Werner Thomas (1990) listed three Indian species i.e. *nigrifrons* Walker, *stigmata* Moore and *khasiana* Thomas under this genus. Werner Thomas (*pers. comm.*) indicated that *Lemyra* Walker would be revised to include a number of species, currently placed under *Spilosoma* Steph. He was revising this group when he died on February 28, 1991. However, Kishida *et al.* (1992) listed these species under genus *Lemyra* in their publication MOTHS OF NEPAL. In the present work, two Indian species, namely *stigmata* Moore and *walkeri* sp. nov. have been studied.

The validity of the new species has been confirmed by comparing it with an allied species of genus *Lemyra,* and those of *Spilosoma*. The species *stigmata* was studied by Inoue (1993), while comparing it with a new species *wernerthomasi* from Taiwan. Thus, only *walkeri* is described and illustrated here in detail.

Lemyra walkeri sp. nov.
(Figs 1- 8)

Head with vertex and frons furnished with pale buff scales, lower half of frons clothed with black scales. Antenna with scape having pale buff scales, flagellum black. Eyes golden-brown, bearing black spots. Labial palpus porrect, reaching lower level of frons and clothed with black scales.

Thorax, collar and tegula covered with pale buff scales; vertex of thorax with dorsal median black streak; pectus black in front. Forewing with ground colour pale buff, with a black, short streak in cell and points on costa and cell, spots below cell and on vein 1A; a medial series of spots angled on medial nervure, then strongly incurved with short streak on inner margin; a postmedial series of short oblique streaks on either side of veins from apex, excurved below median nervure; submarginal spots on either side of veins M_2, M_3 and Cu_1; maculation much stronger on underside; vein M_2 arising from just above lower angle of cell; Cu_1 from before lower angle; Cu_2 from well beyond middle of cell. Hindwing with ground colour whitish buff, a discoidal spot; submarginal spots on Rs and each side of M_2, Cu_2 and 1A; underside discoidal spot not visible, submarginal series prominent; vein Sc + R_1 originating from well beyond middle of cell; Rs from just before upper angle of cell; M_1 from upper angle; M_2 and M_3 from lower angle of cell; Cu_1 from before lower angle of cell. Legs with forecoxae dressed with black scales on underside; femora crimson dorsally, fore femur black ventrally, whereas mid and hind femora fringed with pale yellow scales on underside; fore and midtibia and tarsi yellow; hind tarsi fuscous, with rows of tarsal spines on inner side; outer tibial spurs more than half length of inner ones.

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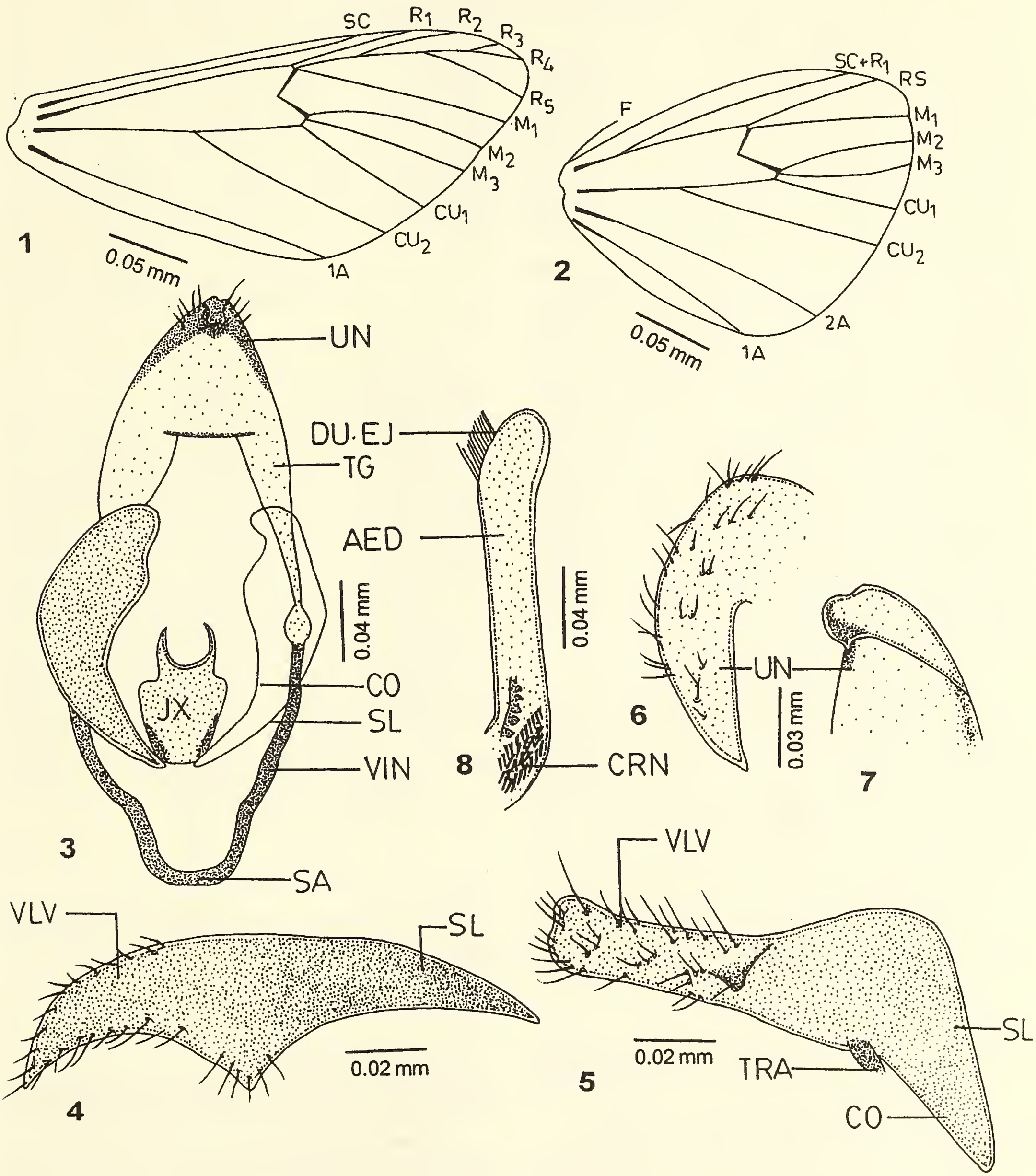

Figs 1-8: *Lemyra walkeri* n. sp., 1. Forewing, 2. Hindwing, 3-8. Male genitalia

Abdomen covered with crimson scales and long, whitish hairs; ventral side bearing pale yellow scales, dorsal, lateral and sublateral series of black spots. Male genitalia with uncus of moderate length, broad at base, curved, tapering towards distal end, tip blunt, visible as pointed in lateral view, dorsally setosed; a slightly developed acrotergite; tegumen well developed, inverted V-shaped, slightly longer than vinculum; vinculum broad, U-shaped; saccus small. Valva simple, basal half broad; sacculus and costa slightly marked; a medial triangular setose projection on costal side; upper half narrow, cylindrical; valvula and cucullus fused into a nearly straight tip; juxta large, distinctly visible into two parts, basal broad and distal bifurcated U-shaped structure, transtilla small, broad at base. Aedeagus long and slender; tip rounded, slightly curved at distal end, both of its walls equally sclerotized; vesica armed with a patch of cornuti arranged in a typical manner, a sclerotized patch above these, with triangular sharply pointed spines. Female genitalia not examined.

Wing Expanse (Half): Male, 22 mm.

Material Examined: Holotype: Male, Arunachal Pradesh, West Kameng district, Bomdila, 2,600 m, 10.ix.1994, Coll. A.P. Singh. Paratype: 2 Male, Arunachal Pradesh: West Kameng district, Bomdila, 2,600 m, 11.ix.1994, Coll. A.P. Singh.

Distribution: India: Arunachal Pradesh.

Remarks: The new species *walkeri* is closely related to *Lemyra stigmata* Moore, however, it differs from *stigmata* in having heavier maculation and wing venation as vein M_2 originates from just above lower angle and Cu_1 from before lower angle of cell in forewing; hindwing with vein Rs arising from just before upper angle of cell and Cu_1 from before lower angle; male genitalia with valva having triangular medial projection; aedeagus short, without any sclerotized projection at distal end; juxta also differs in shape. The species under reference is also clearly distinct from *wernerthomasi* in wing maculation, shape of valva and aedeagus.

Etymology: The name pertains to the eminent lepidopterist, F. Walker.

Abbreviations used: 1A = First anal vein, 2A = Second anal vein, AED = Aedeagus, CO = Costa, CRN = Cornuti, Cu_1 = First cubital vein, Cu_2 = Second cubital vein, DU.EJ = Ductus ejaculatorius, F = Frenulum, JX = Juxta, M_1 = First median vein, M_2 = Second median vein, M_3 = Third median vein, R_1 = First radial vein, R_2 = Second radial vein, R_3 = Third radial vein, R_4 = Fourth radial vein, R_5 = Fifth radial vein, Rs = Radial Sector, SA = Saccus, Sc = Subcosta, Sc + R_1 = Stalk of Sc + R1, SL = Sacculus, TG = Tegumen, TRA = Transtilla, UN = Uncus, VIN = Vinculum, VLV = Valva.

Acknowledgement

I thank CSIR, New Delhi for financial assistance.

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ISEILEMA JAINIANA (FAMILY POACEAE) — A NEW GRASS SPECIES FROM COASTAL TAMIL NADU, INDIA[1]

P. UMAMAHESWARI[2] AND P. DANIEL[3]

(*With one text-figure*)

Key words: *Iseilema jainiana*, new grass, Gulf of Mannar

A new grass, *Iseilema jainiana*, from the Gulf of Mannar coast in Tamil Nadu, is described and illustrated.

Iseilema jainiana sp. nov.
(Fig. 1)

I. laxum Hack. affinis, sed spiculis involucrorum curtioribus (*c.* 3.5 mm longis); gluma inferam oblonga, curtiora (*c.* 3 mm longa) et 5-7 nervata; gluma superam oblongo-elliptica et curtiora (*c.* 3.5 mm longa); spiculis sessilium, gluma inferam, gluma superam et lemmate curtiore (respecte *c.* 3 mm, 2.8 mm, 3 mm et 11 mm longo), et granis curtioribus differt.

Typus: INDIA: Tamil Nadu, Tuticorin district, Gulf of Mannar coast, Kanyakumari - Thiruchendur highway, between Karaichuthu and Padakkapathu diversion, on elevated ground, *c.* 40 m, 26.i.1996, *P. Daniel & P. Umamaheswari* 107240 (CAL, holotypus; MH, isotypus).

Annual; culms tufted, erect, *c.* 60 cm, glabrous. Leaves linear, acuminate, 3-15 x 0.2-0.4 cm, glabrous, glandular or scabrid towards the base; ligules with a fringe of hairs, *c.* 0.4 cm wide; sheaths 2-6 cm long, glabrous, purplish near the node. Panicles up to 15 cm long; spathe boat-shaped, 0.8-2 cm long. Involucral spikelets 4, whorled, staminate, lanceolate, acute, *c.* 3.5 x 1 mm; pedicel terete, *c.* 1 mm long, ciliate at the base; lower glume oblong, obtuse, *c.* 3 x 1 mm, keeled, bearded on the keel; nerves 5-7, prominent; upper glume oblong or elliptic, obtuse or subacute, *c.* 3.2 x 1 mm, 3-nerved; lemma linear-oblong, toothed, as long as the upper glume, membranous, hyaline, palea absent. Lodicules 2, truncate. Stamens 3; anthers *c.* 1.7 mm long. Pedicellate spikelets 2, staminate, elliptic, acute, *c.* 3.5 x 0.9 mm; pedicel *c.* 1.5 mm long, glabrous; lower glume oblong or elliptic, obtuse, *c.* 3.5 x 1 mm; nerves 9, prominent, ridge-like beneath; upper glume oblong, abruptly acute, *c.* 3 x 1 mm, 3-nerved; lemma linear, as long as the upper glume, membranous, hyaline. Stamens 3; anthers 2-2.5 mm long. Sessile spikelet lanceolate-ovate, *c.* 3 x 0.5 mm, awned; lower glume lanceolate-ovate, bifid, *c.* 2.8 x 1 mm, keeled, minutely ciliolate; nerves 2, faint; upper glume oblong-ovate, shortly mucronate, c. 3 x 0.8 mm, 1-nerved; lemma awn-like, *c.* 11 mm long, hyaline for *c.* 1.5 mm at the base, geniculate, purplish-brown for *c.* 4.5 mm, stramineous for *c.* 5 mm; palea oblong, obtuse, *c.* 2 x 0.6 mm, hyaline. Ovary ellipsoid or oblong, *c.* 0.8 mm long; styles 2, *c.* 1.2 mm long; stigmas 2, *c.* 3.5 mm long, plumose, brownish. Grains ellipsoid, cuneate at the base, *c.* 1.5 x 0.5 mm, yellowish.

Fl. & Fr.: December-January.

Habitat: Open dry coastal plains, on red soil, rare.

Distribution: Gulf of Mannar coast, Tamil Nadu.

Iseilema jainiana is allied to *I. laxum* Hack., but differs from it as shown in Table 1.

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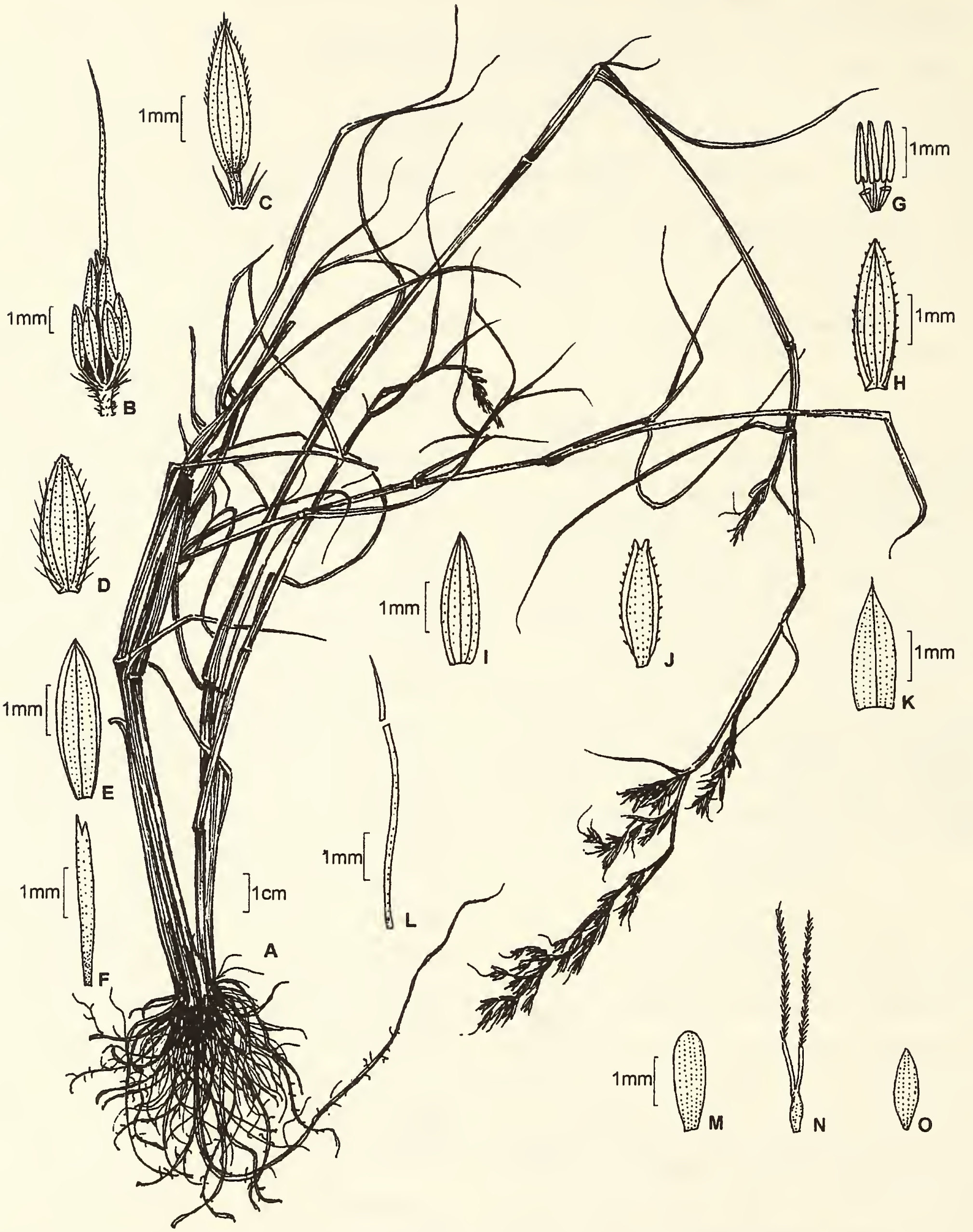

Fig. 1: *Iseilema jainiana* sp. nov., A. Habit, B. Spikelet, C. Involucral spikelet, D. Lower glume of involucral spikelets, E. Upper glume of involucral spikelets, F. Lemma of involucral spikelets, G. Stamens and lodicules, H. Lower glume of pedicellate spikelet, I. Upper glume of pedicellate spikelet, J. Lower glume of sessile spikelet, K. Upper glume of sessile spikelet, L. Lemma of sessile spikelet, M. Palea of sessile spikelet, N. Pistil, O. Grain

TABLE 1
COMPARISON BETWEEN *ISEILEMA LAXUM* AND *ISEILEMA JAINIANA*

Character	*I. laxum* Hack.	*I. jainiana* sp. nov.
1. Involucral spikelets	*c.* 4.5 mm long	*c.* 3.5 mm long
2. Lower glume	ovate, *c.* 4.2 mm long, 7 - 9 nerved	oblong, *c.* 3 mm long, 5 - 7 nerved
3. Upper glume	lanceolate or ovate, *c.* 4 mm long	oblong or elliptic, *c.* 3.2 mm long
4. Sessile spikelets	*c.* 5 mm long	*c.* 3 mm long
5. Lower glume	*c.* 5 mm long	*c.* 2.8 mm long
6. Upper glume	*c.* 4.5 mm long	*c.* 3 mm long
7. Lemma	*c.* 14 mm long	*c.* 11 mm long
8. Grains	*c.* 2 mm long	*c.* 1.5 mm long

Etymology: This species is named after Dr. S. K. Jain, former Director, BSI, Kolkata, who has contributed greatly to the study of Poaceae of India.

ACKNOWLEDGEMENTS

We thank the Director, BSI, Kolkata, for facilities, Dr. V.J. Nair, former Deputy Director, BSI, Coimbatore, for confirming the taxonomy and providing the Latin diagnosis, and Mr. R. Suresh, Sr Artist, BSI, Coimbatore, for the illustration. This study is part of a project on the angiosperm flora of the Gulf of Mannar Biosphere Reserve funded by the MoEF, Govt of India, for which P. Umamaheshwari thanks the Ministry.

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REVIEWS

1. THE BIRDS OF ASSAM, by Anwaruddin Choudhury. Published in 2000 by Gibbon Books & WWF-North-East Regional Office, Guwahati. (25.5 x 19 cm), pp. 240. Price Rs. 575/-.

Natural History, especially ornithology, is a subject in which amateurs have played a major role in its advancement. Much before 'professional' ornithologists with M.Sc. and Ph.D. degrees came on to the scene, Indian ornithology, as elsewhere, was dominated by highly interested, and extremely meticulous, dedicated amateurs. E.C.S. Baker who pioneered the work on the birds of northeast India was a police officer, while A.O. Hume, the father of Indian ornithology, was a civil servant. After Independence, Dr. Sálim Ali, who also was a thorough scientist with no great university degrees, dominated Indian ornithology. It is difficult to place Dr. Anwaruddin Choudhury in any category. He has an M.A. in Geography, Ph.D. in Primatology, works in the Assam Civil Service and is a naturalist by heart. He is the founder Chief Executive of The Rhino Foundation for Nature, a non-governmental organisation in northeast India, and is at present the Director of Tea for Assam State. He is a prolific writer, with more than 300 articles and research papers, eight books and monographs. Anwar is interested in wildlife and nature photography, cartography, philately and drawing.

It is a pleasure to review Anwar's recent book THE BIRDS OF ASSAM, a boon for those interested in the birds of this region, as it gives up-to-date information on them. All the birds recorded or reported within the geographic limits of Assam have been listed. The book starts with a brief Introduction, which tells us the aim and scope of the book, nomenclature used, and keys and abbreviations. It is followed by succinct chapters on 'History of Ornithology', 'Bird Migration' and 'Birds in Different Habitats'. I found the third chapter very informative as it gives the extent of different forests types in Assam, important grasslands, rivers and wetlands. The fourth chapter 'Birds and Man' discusses birds useful or harmful to man; hunting, trapping and the famous Jatinga bird migration. The fifth and sixth chapters 'Selected species accounts' and 'Notes on some other species' which contain English, scientific and Assamese names, distribution in and outside Assam, ecology, historical status, and current population and conservation requirements, are the backbone of the book. Distribution maps of each species and beautifully crafted line diagrams of birds, all by Anwar, embellish the species account. The seventh chapter lists all the 820 species and subspecies reported from Assam. In 1990, Anwar had published a 'Checklist of the Birds of Assam' which included 946 species and subspecies. However, this book has mainly species, with a few exceptions where two or three subspecies occur within Assam. Anwar has used Ali & Ripley's classification, but has also included new English names (e.g. woolly-necked stork for white-necked stork, short-toed snake eagle for short-toed eagle). In the appendices, he has given lists of ornithological and conservation bodies, journals and newsletters, good bird watching areas, national parks and sanctuaries of Assam, and major wetlands and tanks of Assam. The bibliography contains 286 references. The book ends with an index of English and scientific names. In a nutshell, nothing that makes a good scientific book is missed. The only drawback is the picture quality, though the original pictures must have been good. The printing is substandard.

Anwar's book is a valuable addition to the ornithology of Assam, and will remain so for many years till he updates it. I wish we had such books from the other states of India.

■ ASAD R. RAHMANI

2. FORESTRY FOR TRIBAL DEVELOPMENT by R. S. Shukla 'Greener'. Published in 2000 by Wheeler Publishing, Allahabad. (16.1 x 24.1 cms), pp.xvii + 274. Paperback edition price Rs. 250/-.

Comprising of 12 chapters, the book covers the anthropological and demographic aspects of the main tribes of India, forest types, constitutional provisions, tribal economy and various tribal beneficiary schemes. Aspects like Forestry for Tribal Development, Distribution of Forests and Tribals in India, Distribution of Wildlife and Tribals in India, religion, myths, customs and social organization; Culture and Art of Tribals have also been covered. Forest policy and legislation, five year plans and tribals, forest products, shifting cultivation and tribals, and their dependence on the forest have been discussed in some detail. The chapter on medicinal plants is especially interesting.

The importance of tribals and their societies is acknowledged constitutionally and the creation of the Ministry of Tribal Development will give an impetus to tribal welfare. This subject is now a part of the curriculum of the Forest Services. The description of tribal life and folklore makes for valuable reference material within the covers of a book. The author has rightly pointed out that forestry programmes have to be in consonance with the socioeconomic fabric of tribal culture. Emphasis should be on empowerment, security and opportunity to tribals to help strengthen their symbiotic relationship with their habitat.

The life of tribal communities like the Santhals, Todas and Nagas have been highlighted with interesting insights into their culture and folklore. Tribal population in various States is also enumerated, districtwise, like in Gujarat, which is home to one of the most ancient tribes, the Bhils, in the country, and the largest tribal group in the State.

The wealth of information, especially anthropological details are interesting and informative. The book will be useful for anthropologists, administrators, policy makers, environmentalists and organizations concerned with tribal welfare. It provides in-depth knowledge on forests and environment in the context of tribals and will be relevant to any concerned citizen with sensitivity towards the disadvantaged. The present effort should also help sensitize the Forest Department to the plight of tribals at the receiving end of development projects. This is a welcome departure from the British legacy, which continued till the late 1970s and which laid emphasis on rigid attitudes and policing of forests rather than a sensitive approach to human problems.

Unfortunately, the editing leaves much to be desired. In Chapters like 'Distribution of Wildlife' and 'Tribals in India' a cursory and casual approach to the topic is apparent as indicated by a number of wrong spellings, like paradeet for parakeet, holock for hoolock, Valvador for Velavadar and incorrect information like the wild ass is found only in the Rann of Kutch, when it is also found in Ladakh. IUCH for IUCN, Permitive Tribes for Primitive Tribes! Similar howlers occur in the Chapter on 'Medicinal plants'. Such glaring mistakes, which occur throughout the book, reflect badly on the editors. At times, the book drifts and jars the reader who is suddenly confronted with an irrelevant statement in the midst of a well-structured paragraph. Moreover, topics included with obvious lack of expertise gives a feeling that it is an attempt to flesh out the book.

■ S. ASAD AKHTAR

3. A BIBLIOGRAPHIC INDEX TO THE ORNITHOLOGY OF THE INDIAN SUBCONTINENT by Aasheesh Pittie. Produced by the compiler (2001). CD Rom containing approximately 18,000 references to publications on the ornithology of the Indian region — accessed by a retriever version of the bibliography (database) software Papyrus. Price: Rs. 1,000/- for institutions and Rs. 500/- for individuals. For details email aasheesh@vsnl.net.in or write to 8-2-545, Road No. 7, Banjara Hills, Hyderabad 500 034.

I felt a little odd and thought the task too dry when I was asked to write a review of a compact disc, and that too one that comprised almost entirely of bibliographic records. However, there was no option, as I work in the ENVIS (Environmental Information System) Centre at the BNHS, a project of the Ministry of Environment and Forests, which maintains its own database on Indian ornithology and inland wetlands.

The compact disc, which is to be downloaded into one's computer (12.2 MB hard disc space), is the work of Aasheesh Pittie, a birder of the Birdwatchers' Society of Andhra Pradesh and a member of the BNHS. The keyword-based database contains about 18,000 references of publications on the ornithology of the Indian region and is intended to facilitate literature search for those interested in birds. The product has come out after more than two decades of work, and for those who are not aware of it, Aasheesh had brought out a bibliographic index of the papers of the *Journal of the Bombay Natural History Society* (Volumes 1-90) and 10 volumes of *Stray Feathers* in book form in 1995. Additionally, he indexed Volumes 20 to 31 of the *Newsletter for Birdwatchers,* which were brought out as an issue of the *Newsletter* (Vol. 34, No. 3) in 1994.

A major problem that confronts computer users is the plethora of software programmes in the market — one could be very literate in one and a total loss with another. Added to this is the release of new versions of the same product every few years — money for the software manufacturers, but headaches for users. Additionally, there is the problem of the two operating systems, DOS and Windows. People used to Windows tend to look down on or are wary of DOS based operating software since one has to learn, remember and type in commands to work on them. Being used to a Windows based database programme, I felt a little nervous about trying out Aasheesh's DOS based software, but found it very user friendly and soon got the hang of it, as Aasheesh had assured in his introduction to the bibliographic index.

One of the problems of the existing bibliography software is the absence of an automatic warning system to let one know if a record has been entered twice — we find this a problem at ENVIS. I got a case of double entry the first time I tried a retrieval of records from Aasheesh's database, which was intimated to him. However, I expect duplication of records to be less of a problem with Aasheesh's database as he has almost single-handedly entered the records himself and is known for his meticulousness. To test the efficacy of the software, I gave retrieval commands for my own papers. A search for 'florican' did not list my papers among the 10 others, but 'Manakadan' churned out the two that I have published. Why? However, a similar search for '*Anser*' and 'Manakadan' brought out my record of the sighting of the greater white-fronted goose *Anser albifrons* in Rollapadu Wildlife Sanctuary, Andhra Pradesh.

This database of 18,000 odd entries covers the published work of the Indian region covering Afghanisthan, Bangladesh, Bhutan, India,

Maldives, Myanmar, Nepal, Pakistan and Sri Lanka, and also Tibet. More than 600 different journals, newsletters, etc., have been covered. Also books, theses, unpublished reports, and chapters from books, papers and Internet reports. References are indexed on keywords and can be retrieved on the basis of authors, countries, sites, scientific names (currently used), group or family names of birds (herons, raptors) but not on the basis of common names such as little egret, biological characteristics (breeding, feeding, etc.) and ornithological subjects (bird watching, checklist, catalogues, etc.) — what more can one want?

Aasheesh cautions that some of the references may not be accurate as their source is 'second-hand', having been taken from the reference sections of various publications. While processing queries for our own database at ENVIS, we have, on a number of occasions, come across wrongly cited references, sometimes even the journal in which the paper was published is incorrect! Indian birders tend to give the reference section of their papers the least importance, a major headache for other researchers and database managers [and editors!]. So users of Aasheesh's database (and our ENVIS Centre's database), please do not get puzzled if you sometimes do not find the paper in the journal cited!

I applaud Aasheesh for the hard, painstaking work he has put into this endeavour. Being in the same field, I know how tedious, boring and eye-straining it is with databases, and like Aasheesh said, "a puzzlement to his family". I guess the cutting of the CD is as good as a healthy, bonny baby after all the labour pains! This is a landmark achievement in Indian ornithology. The BNHS too has had plans to bring out the key word based ornithological bibliographic database available at our ENVIS Centre in a CD form, but Aasheesh is the early bird who caught the worm!

Tailpiece: After one punches the exit option for the programme, a message is flashed across the monitor. Why do I mostly get "Don't worry — everyone has days like this!"Does the programme also make astrological forecasts or mind read, or is this the 'fate' of database personnel?

■ RANJIT MANAKADAN

■ ■ ■

MISCELLANEOUS NOTES

1. HOOLOCK GIBBON (*HYLOBATES HOOLOCK*) FEEDING ON LICHENS

During the behavioural studies of hoolock gibbon (*Hylobates hoolock*) in the Gibbon Wildlife Sanctuary (WLS) and Borajan Reserve Forest (now WLS), in the upper Assam forest circle (India), we observed gibbons feeding on lichens, growing on the bark of trees. The forest may be categorized under Tropical Evergreen to Semi-evergreen and Moist Dipterocarp types. Gibbons are known to be frugivorous (Chivers 1984). Our study reveals that lichens constituted 2.7% of the hoolock gibbon's diet in Gibbon WLS and 1% in Borajan WLS, during the pre-monsoon months (March to May) in1999.

The identification of lichens is currently underway, but the types were confirmed as typical foliose and fructose.

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2. PREDATION BY TIGER *PANTHERA TIGRIS* LINN. ON GAUR *BOS GAURUS* H. SMITH IN PENCH TIGER RESERVE, MADHYA PRADESH

During a study in Pench Tiger Reserve (PTR), Madhya Pradesh on gaur (*Bos gaurus*) by the Wildlife Institute of India, predation on gaur by carnivores was observed from 1996 to 1999. The PTR (78° 55' E to 79° 35' E and 21° 8' N to 22° N; 757.85 sq. km) lies in the southern lower reaches of Satpura hill ranges in Madhya Pradesh and comprises of the Sanctuary, National Park and Reserved Forests. The vegetation falls under Tropical Moist Deciduous and Tropical Dry Deciduous types (Champion and Seth 1968). The terrain is undulating, with hillocks and ravines, varying from 220 m to 650 m.

Between February 1996 and September 1999, 76 kills of wild ungulates were located in PTR. Of these, only 5 were of gaur — two yearlings, two bulls and one cow (Table 1). All were tiger (*Panthera tigris*) kills, except one yearling male gaur in 1996, whose predator could not be ascertained, as the kill was 4-5 days old and no tracks or other signs were seen. Three adult gaur kills had deep puncture marks, either on the hind or forelegs or both, or on the throat. In two of the adult bulls killed, the cervical vertebrae were broken. The yearling gaur had bites on both the throat and the nape. No signs

TABLE 1
GAUR (*BOS GAURUS*) KILLS IN PENCH TIGER RESERVE

Date	Age & Sex	Predator	No.	Remarks
10.04.1996	Yearling (Male)	Unknown	1	
14.04.1997	Yearling (Male)	Tiger	1	(Infected) Foot and Mouth Disease
26.04.1997	Bull (4-5 years)	Tiger	1	
10.05.1997	Bull (5-6 years)	Tiger	1	
13.06.1997	Cow (4-5 years)	Tiger	1	Pregnant (7-8 months old foetus recovered from the womb on post-mortem)
		Total	5	

of severed tendons, suggesting biting of hock and hamstring, were recorded in any of the gaur kills.

On two occasions, the tiger was sighted feeding on gaur kills (April 26 and May 10, 1997). The flesh from the rump was consumed in both the kills. To determine how the prey was killed, the kill sites, carcasses and tracks were examined. In both cases, the gaur was chased by the tiger for about 75-100 m before it was finally brought down. At places, the muddy ground had been churned, and had several deep hoof marks, indicating that the animal had struggled for survival. The gaur killed on May 10, 1997 had defecated and urinated at one place, during the chase.

Several hunters and naturalists have described the hunting technique of the tiger. It is known to prefer the throat for killing prey larger than itself (Sunquist 1981, Karanth 1993). For smaller animals, it attacks the nape, resulting in a broken neck or dislocation of head from the vertebral column (Schaller 1967, Sunquist 1981, Karanth 1993).

Karanth (1993) observed bites on the nose of some gaur carcasses in Nagarhole National Park, Karnataka. Schaller (1967) reported that an adult gaur bull killed by a tigress in Kanha, Madhya Pradesh had deep canine marks on the back of the neck and throat. He also found a gaur calf kill with canine punctures in the nape and at the base of the skull and claw marks on the rump.

Biting through the hock and hamstring of large prey like cattle, buffalo and gaur by tiger are reported (Brander 1923). But in PTR no such evidence was found on gaur kills. The tiger is also known to break the cervical vertebrae of large prey like cattle or buffalo (Brander 1923).

Tiger (*Panthera tigris*), leopard (*Panthera pardus*) and dhole (*Cuon alpinus*) are the major predators found in PTR. The tiger is known to be the key predator of gaur (Johnsingh 1983, Karanth 1993, Rice 1986, Schaller 1967). The same holds true for the study area. Leopard is also known to predate on calves and yearlings of gaur, but no such incident was noticed in PTR.

The puncture marks on the fore or hind legs of gaur in PTR could have been wounds inflicted by the tiger to prevent the escape of the prey, rather than to hock and hamstring. This would also facilitate hunting large prey and help to avoid injury to the tiger. Since there were no claw or canine marks detected on the nape of the two gaur bull kills in PTR, the cervical vertebrae could have broken under the impact of their large body weight when the bulls succumbed and fell to the ground.

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3. THE ECHOLOCATING ROLE OF EYES IN INSECTIVOROUS BATS

(*With one plate*)

The power of flight and ability to echolocate prey are responsible for the tremendous evolutionary success of bats. They skilfully navigate in pitch darkness over hill and dale, dextrously hunting for insects within brambles, thicket and bushes. D.R. Griffin coined the term 'echolocation' in 1944, to describe the method of self-information in which one organ emits a sound signal (the sonar apparatus) and another organ of the same animal receives it (radar mechanism). There are two suborders of bats: 1) the echolocating Microchiroptera and 2) the fruit and flower-visiting Megachiroptera or flying foxes of the Old World. Echolocating bats not only 'locate' a target, but also analyze its features; for example they distinguish prey from non-prey, and smooth from rough surfaces for landing. Since the term echolocation does not describe the full capacity of this acoustic information system, Neuweiler (1990) suggested the term 'audification' which is analogous to visualization.

The power of echolocation has conferred such advantages and glamour to microchiropteran bats, that extensive work has been done on this aspect. But surprisingly little is known about the precise use of their eyes in vision and prey capture. The only reference that Altringham (1996) makes to the function of vision in prey capture is that of Bell (1985) who discovered that the Californian leaf-nosed bat *Macrotus californicus*, a gleaner, used prey-generated sound and low intensity echolocation in localizing its prey. Under laboratory conditions, when the illumination was matched to bright moonlight, the bats located their prey by echolocation in only one third of the time "relying on vision for the remainder in the absence of prey movement and sound" (Altringham 1996). Larger carnivores such as the Australian ghost bat *Macroderma gigas*, the Indian false vampire *Megaderma lyra* and *Cardioderma cor*, also have relatively large eyes, compared to exclusive insect feeders such as *Hipposideros speoris* and *H. bicolor*. There are, of course, many cues that hearing in microchiropteran bats is much more efficient than vision. One convincing morphological cue is that the auditory regions of the brain of insect eating bats are disproportionately larger than the optic regions, and are apparently specialized to receive, process, store, and retrieve information about the environment from soft echoes.

We have investigated the foraging strategies, 'best hearing frequencies' (BHF), and echolocation of eight species of insectivorous bats of Madurai (9° 58' N; 78° 10' E) (Neuweiler 1984; Neuweiler *et al.*, 1984; Habersetzer and Marimuthu 1986; Link *et al.,* 1986; Neuweiler *et al.,* 1988) *Tadarida aegyptiaca*, *Taphozous kachhensis*, *Taphozous melanopogon*, *Rhinopoma hardwickei*, *Pipistrellus mimus*, *Pipistrellus domeri*, *Hipposideros speoris* and *Hipposideros bicolor*. We have not conducted specific experiments on the role of eyes in flight; landing or prey captures in any of the species of bats we studied. Extensive data on the biology, chronobiology, (Subbaraj and Chandrashekaran 1978; Marimuthu *et al.*, 1978) behaviour (Chandrashekaran and Marimuthu 1987; Radhamani *et al.*, 1990), and ecology of *Hipposideros speoris*, *Taphozous melanopogon*, *Taphozous kachhensis*, and *Rhinopoma hardwickei* have been published. *Taphozous kachhensis* and *Hipposideros speoris* do perceive colours (Sripathi 1982, Joshi and Chandrashekaran 1985) and so do four other species of microchiropteran bats (Hope and Bhatnagar 1979a, 1979b). The Madurai bats forage as efficiently on new moon nights and during a lunar eclipse as they do on full moon

Chandrashekaran, M.K.: *Hipposideros bicolor* PLATE 1

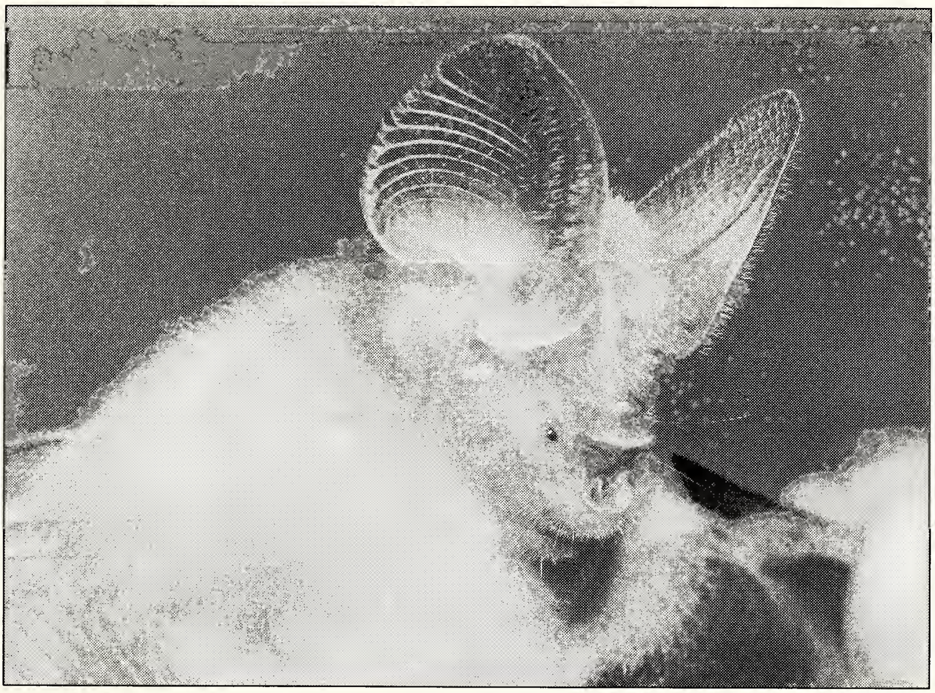

Fig. 1: A male adult *Hipposideros bicolor* (Note the very small eyes. This bat emits ultrasonics of a frequency of 155 kHz pure tone for echolocation and can hunt for insects in bramble and thicket.)

nights (Usman *et al.* 1981).

In field ethological studies on foraging in bats, it is difficult to create conditions of absolute darkness, as there is some light even on new moon nights. In fact, in our experiments on foraging by microchiropterans, the bats were attracted to insects that swarmed around an artificial (petromax) light source in the open, enabling bat counts. Which is why it becomes difficult to rule out with utmost certainty the possibility of participation of vision in prey capture. However, Marimuthu and Chandrashekaran (unpublished) demonstrated that *Hipposideros speoris* could catch prey in an absolutely dark cave. The two species of hipposiderid bats which inhabit adjacent caves in Madurai in the Samanar Hills complex have the smallest eyes among the insectivorous bats of Madurai (Plate 1, Fig. 1), which interestingly emit the highest frequency of ultrasonic pulses. *H. speoris* emits pure tone of *ca* 132 kHz and *H. bicolor* of 155 kHz.

The account that follows describes a chance discovery, which is nevertheless valuable. G. Marimuthu was feeding bats held captive in activity cages (Marimuthu *et al.* 1978) inside a natural cave, 40 m from the cave mouth. The cave was absolutely dark at this place, hence he used a battery-operated torch, tied to the head, with a 'safe' red light of more than 610 nm. He was holding a live cockroach with a pair of forceps (from which the elytra, wings, cuticle and innards had been removed) when he had turned the torch off. Suddenly, he felt a jerk on his hand. Surprised, he switched on the torch to find the cockroach missing. On searching, he found a bat hanging from the ceiling of the cave chewing up the snatched cockroach. The free-flying bat had wrenched the wriggling cockroach off the forceps. This prey capture in darkness was obviously accomplished solely by means of echolocation in which *H. speoris* employs CF/FM signals of 5-10 msec of pure tone of *ca* 132 kHz terminated by a brief FM sweep (Neuweiler *et al.*, 1984).

Reverting to the role of the eyes, insectivorous bats like *Hipposideros speoris* and *Rhinopoma hardwickei,* are known to 'sample light' 10-15 minutes prior to synchronized exodus, which coincides with sunset in Madurai (Marimuthu *et al.* 1981). When the twilight intensity falls below 0.3 lux (which is roughly the intensity of moonlight) the bats fly out. In adult mammals, the retinal photoreceptors are the only known route for light perception, and therefore blinding in a squirrel *Funambulus palmarum* and the mouse *Mus booduga*, resulted in free-running circadian rhythms (Navaneethakannan and Kumaraswamy, 1987). We have further shown that the circadian rhythms in the activity of *Hipposideros speoris* entrains to daylight of intensities which are 5 to 30% of starlight (0.002 lux) for *ca* 90 min every 24 hrs (Joshi and Chandrashekaran 1982). In laboratory experiments with *H. speoris* we also demonstrated that brief flashes of light of 0.5 msec shifted the circadian rhythm as a function of phase (Joshi and Chandrashekaran 1984).

On the basis of our findings, we conclude that the eyes of insectivorous bats such as *Hipposideros speoris* may not be very efficient in prey capture as they are small. The recurrent 'sampled' light pulses at the cave mouth, of a few minutes, that the bats are exposed to every 24 hrs, entrain their biological clocks. We further propose that it is not unlikely that the eyes play a crucial role as photoreceptors in this circadian entrainment.

ACKNOWLEDGEMENTS

I thank G. Marimuthu for help in performing the arduous experiments inside a natural cave in Keela Kuyil Kudi rock complex.

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4. THE MALABAR SPINY DORMOUSE *PLATACANTHOMYS LASIURUS* IN MUDUMALAI WILDLIFE SANCTUARY, TAMIL NADU

The Malabar spiny dormouse *Platacanthomys lasiurus* has been reported by Prabhakar (1997) in the Indira Gandhi Wildlife Sanctuary, Tamil Nadu at 650 m; Ganesh (1997) in the Kalakad Mundanthurai Tiger Reserve, Tamil Nadu at 1,100 m; Sankar (1996) in Upper Bhavani Hills at 2,000 m and also by Jayson and Christopher (1995) in Peppara Wildlife Sanctuary, Kerala at 600 m elevation.

The Mudumalai Wildlife Sanctuary is situated in Nilgiri district, Tamil Nadu (11° 32'-11° 43' N; 76° 22'-76° 45' E), with an altitude range of 350-1,266 m above msl. It bears vegetation types varying from Moist Deciduous and Semi-evergreen in the Benne forest, through Dry Deciduous Forest over most of the Sanctuary to Dry Thorn in Moyar.

The ecology and distribution of small

mammals in the different habitats of Mudumalai Wildlife Sanctuary, was studied in 1997. Small mammals were trapped in Sherman traps placed on the ground in the chosen study grids, baited with coconut. The Malabar spiny dormouse was recorded at an elevation of 1,000 m in the semi-evergreen forest of Benne, in May. One individual was captured, preserved and later identified. Its morphometric measurements were: head-body length 12.6 cm; tail length 13.5cm; hind foot length 2.5 cm; weight 82g (live individual).

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5. THE WILD ELEPHANT *ELEPHAS MAXIMUS* IN MIZORAM

(*With a text-figure*)

The Asian elephant *Elephas maximus* Linn. is distributed in northeastern India in 14 discrete populations (Choudhury 1999). The populations in Mizoram and Tripura were treated as a single one, with probable movement through Chittagong Hill Tracts of Bangladesh. A field trip was made in April 2000 (for 14 days) to assess the status of elephants in Mizoram. During this trip, all the known sites were visited and the Forest Department officials, local hunters/ poachers and other tribal villagers were interviewed. The state of Mizoram (21° 58'-24° 30' N, 92° 16'-93° 25' E) (area 21,081 sq. km) (Fig. 1) was referred to in the past as the Lushai Hills of southern Assam. The entire area is hilly, being part of the Himalaya-Arakan mountain chain. The terrain is dissected mostly by north-south flowing rivers, which make a series of parallel ranges. The highest ranges are towards east with Phawngpui or Blue Mountain (2,157 m above msl) and Lengteng (2,141 m above msl) peaks. The lowest evaluation is in the riverbeds near Assam-Mizoram and India-Bangladesh border (less than 100 m above msl).

Till the 1950s, the elephant was widespread all over the state, especially in the north, west and south (source: local reports by villagers, and A. Laskar, S. Laskar, *pers. comm.*). However, it was never common in recent memory, as its meat was relished by all the tribes (Mizo, Lai or Pawi, Mara or Lakher, Bru or Reang, Chakma, and Hmar) and it was regularly hunted. In the 1960s, when insurgency started, modern firearms became easily available, resulting in a phenomenal increase in poaching. At the same time, ivory also became an important target (especially for sale in southeast Asia markets to buy arms). With the gradual increase in human population, the destruction of forest through felling and *jhum* (shifting cultivation) has also increased. By the 1970s, the main elephant strongholds remained only in the western and southern areas, with small populations elsewhere. By 1980s, the northern elephant population was reduced to stray

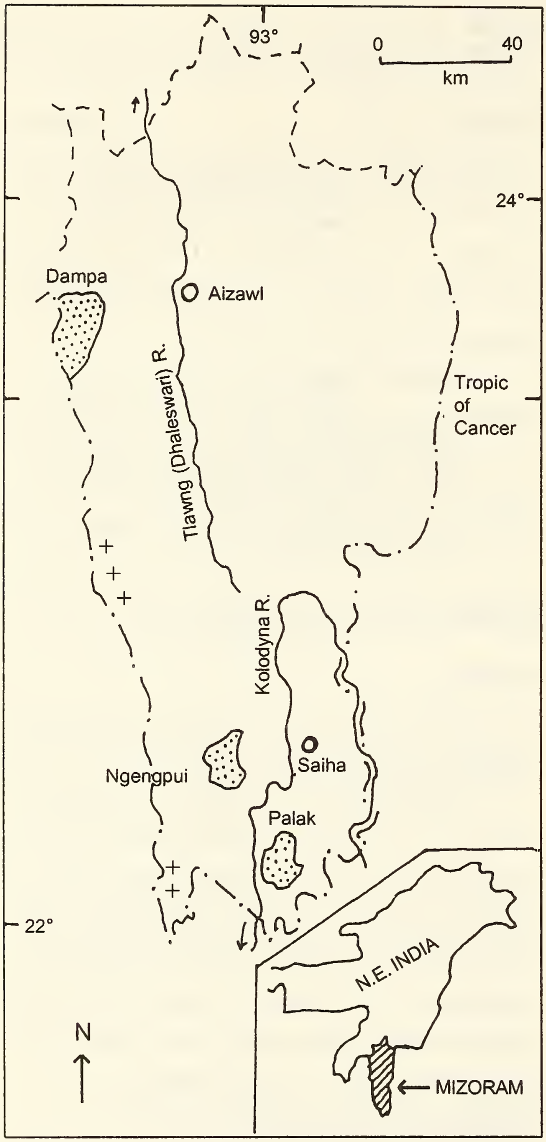

Fig. 1: Map of Mizoram showing the current distribution of elephants [stippled] and occasional migrants from Bangladesh (+)

individuals with no future, while the western and southern populations were confined to a few pockets (A. Laskar, *pers. comm.*). In the 1990s, the elephant survived only in three areas, with a few stray animals in other areas. In the mean time, the human population of Mizoram grew from 3,32,000 (0.33 million) in 1971 to 6,86,000 (0.69 million) in 1991, i.e. more than double in two decades, indicating a phenomenal corresponding increase in *jhum* cultivation.

The main elephant population is now confined to Ngengpui Wildlife Sanctuary (110 sq. km), Lawngtlai district in the far south, and Dampa Sanctuary and Tiger Reserve (500 sq. km), Mamit district in the west. In 1996, a census party of the Forest Department located only four elephants in part of Dampa. Unfortunately, a *makhna* from this population died in 1998 due to accidental strangulation near Lallen. While sliding down a slope, its head got sandwiched between two tree trunks from which it could not recover itself (Jain and Saandeep 2001). These animals occasionally cross over to Bangladesh also. Local reports indicate that more than 10 elephants were present in the early 1980s. At that time, there was a lone bull at Bolung (S. Laskar, *pers. comm.*) northeast of Dampa.

Ngengpui Wildlife Sanctuary and adjacent southern areas have the largest population of elephants in Mizoram now: however, only of eight animals. Old villagers of Ngengpui and Khawmawi report that there were more than 20 animals in the early 1980s. These elephants move out of the Sanctuary to the Ngengpui Reserved Forest (Lunglei district) as well as unclassed forests near Mampui.

The third group in the state is in Saiha district, around Palak Dil (Dil = lake). Only three are surviving from what was a fairly large population of at least 50 in the 1970s. According to the elders of Phura village, most of them were shot dead for meat and tusks by extremists. The surviving three cause much damage to standing paddy at Phura valley, but the villagers (Mara or Lakher tribe) do not retaliate, in consideration of the very low population and a vanishing heritage.

Stray elephants, often in small herds, have been reported from the forests northwest of Tlabung (Demagiri) in Lunglei district and Parva

in Lawngtlai district. These are occasional immigrants from Bangladesh, especially during the paddy season.

These are no reports of occurrence of elephants in recent years from Aizawl, Serchhip, Kolasib and Champhai district.

From the above account, it seems that the total number of elephants in Mizoram is only 14, with some seasonal migrants from Bangladesh. Their chances of long-term survival in the wild in Mizoram are bleak, as the existing herds are not only very small, but also severely fragmented, with no possibility of contiguity.

Habitat destruction and poaching continue to be major threats. The decrease of population in Ngengpui (from 10 in 1993 to 8 in 1997) indicates unreported poaching. Protection measures in Dampa and Ngengpui should be strengthened. Part of Dampa is now virtually out of bounds due to insurgency by the Bru (Reang) militants. Palak Dil and adjacent forests (about 40 sq. km) should be declared as a wildlife sanctuary (it is also the largest lake in Mizoram). To avoid inbreeding and maintain genetic quality, translocation of one or two elephants from Assam (where troublesome elephants are occasionally captured) or Meghalaya to Dampa and Ngengpui could have solved the problem, but the prevailing situation makes it unlikely in the near future. With better protection, Dampa and Ngengpui could support larger populations. Conservation education among the local villagers, with the help of NGOs, is also strongly recommended.

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6. ON LITTLE GREBES *TACHYBAPTUS RUFICOLLIS* BREEDING NEAR K. KARUNANIDHI NAGAR, TIRUCHIRAPALLI, TAMIL NADU

Little grebes *Podiceps* (=*Tachybaptus*) *ruficollis* were common around Trichinopoly in the 1930s. One Mr. C. McConway had collected over one hundred eggs, and washed them (with Vim and Monkey brand soap) to find out whether the brown coloration on the eggs was original or acquired. He reported that the coloration was no indication of incubation stage (Baker & Inglis 1930. THE BIRDS OF SOUTHERN INDIA, p. 485). Sixty to seventy years later, they are still common, despite the developmental changes in their habitat. At the onset of the southwest monsoon, when the ruddy brown earth is carried into ponds by rainwater and settles at the bottom, the pond water becomes clear. Little grebes arrive noiselessly during cloudy afternoons in hundreds, and run on this clear water surface, beating their wings. They stay on, breed and leave in mid-January. The three main water bodies frequented by the little grebes are Vadugapatty Periakulam,

TABLE 1
TEN YEAR COUNTS OF LITTLE GREBE POPULATION AND NESTS

Year/Month	Population Size	Year/Month	No. of Nests
1. 1989 July	150+		No count
2. 1990 August	280+		"
3. 1991 August	210+		"
4. 1992 July	180+	1992/September	68
5. 1993 August	250+	1993/September	116
6. 1994 August	330+	1994/September	128
7. 1995	No arrivals		
8. 1996	"		
9. 1997 July	300+	1997/October	108
10. 1998 July	300+	1998/October	126

Senkulam and Sathanur Kulam. The total water spread of the three tanks is 8.2 sq. km with 1.4 sq. km sheltered bush margins. My counts of birds and nests during the last 10 years are given in Table 1.

One pair of little grebe had built their nest in a well 3 m in diameter, close to Olaiyur railway crossing, adjoining the irrigation canal. The water level of the well would rise and fall, depending on the level of the canal water. Though the floating nest of the grebes was first found accidentally in September 1995, I checked and saw the nests each year. One nesting a year was observed in the southwest monsoon.

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7. IRIS COLORATION IN THE LARGE EGRET *CASMERODIUS ALBUS* AND MEDIAN EGRET *MESOPHOYX INTERMEDIA* (FAMILY ARDEIDAE)

The Simpson Industrial Estate, Sembium, in the northern part of Chennai (Madras), is a well-known heronry in Tamil Nadu, India. Species that breed in the confines of the Estate are the large egret *Casmerodius albus*, median egret *Mesophoyx intermedia*, little egret *Egretta garzetta*, black-crowned night-heron *Nycticorax nycticorax*, little cormorant *Phalacrocorax niger* and Indian shag *P. fuscicollis*.

Ali and Ripley (1987) mentioned the coloration of the iris of the median egret as lemon-yellow, and that of the large egret as yellow for race *alba* and bright lemon-yellow for *modesta*. Roberts (1991) stated it as yellow in the median egret, but did not describe the colour of the iris in large egret. Brown *et al.* (1982) described it as ruby for the median (race: *brachyrhyncha*) and brilliant red for the large egret (race: *melanorhynchos*).

During 1996-97, about 50 pairs of large egrets bred in Simpson Estate. In the early part of the breeding season in November, the birds sported black bills, flesh coloured tibia, orbital skin ranging from bright yellowish-green through bright bluish-green to dark bluish-green. The colour of the iris was yellow in all the birds. By January 4, 1997, the bills of the birds had started yellowing at the base, the colour of the orbital patch and tibia regressed. During this period, one of the birds of a pair was recorded to have a red iris. However, the iris reverted to yellow again after three weeks.

In mid-February, most of the birds were feeding chicks in various stages of growth.

During this time, five birds started courtship display. Of these, two had a pale red iris. The bills were black, the orbital skin bright green, and the tibia pale flesh coloured. The other three birds had a pale orange iris, the orbital skin and bill coloration was as in the other two, but the tibia was bright flesh coloured. Two of the birds with orange irises paired off and started nesting. It was noted that the pale red or pale orange colour of the iris persisted in bright sunlight and in the shade. In earlier observations of 10-30 breeding median egrets, from 1991 to 1996, the iris under bright or diffused sunlight was light orange to bright red in some of the birds. But when in shade (as when the bird ducks to accept nest material from the mate), the iris reverts back to the normal yellow colour.

Change in iris coloration has been recorded for certain egret species elsewhere. Hancock and Kushlan (1984) mention a brief ruby-red flush of the iris (from yellow) prior to egg-laying in the large egret in Australia and North Africa. They do not mention iris colour change in the median egret, but report it in the little egret *Egretta garzetta* (turns red during the height of courtship) and the grey heron *Ardea cinerea* (changes from deep yellow to deep orange). My observations on the change in iris colouration in the large and median egrets are interesting, as it has not been reported for the median egret, or for *E. garzetta* or *A. cinerea* in India. The significance of the changes in iris coloration, the colour variations under shade and sunlight, and why they do not appear in all individuals of a colony, is yet to be known.

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8. SIGHTING OF THE BLACK STORK *CICONIA NIGRA* AND LESSER ADJUTANT-STORK *LEPTOPTILOS JAVANICUS* AT NAGARHOLE NATIONAL PARK, KARNATAKA

Nagarhole National Park (NP) (643 sq. km), along with the Bandipur Tiger Reserve (875 sq. km) and Mudumalai Wildlife Sanctuary (325 sq. km) to the southeast and the Wynaad Wildlife Sanctuary (350 sq. km) to the southwest, form a part of Nilgiri biosphere, the largest protected forest tract in peninsular India. The bird life in this region is impressive, due to a dense forest cover interspersed with innumerable rivulets that feed the Kabini river. The existing bird list has nearly 270 species (Anon 1987), and during my visit to the National Park between January 12-14, 1999, I sighted 97 bird species.

On the last morning of my stay at the Kabini River Lodge at Karapur village, located about 8 km to the east of Sunkadakatte Forest Rest House, Nagarhole National Park, I decided to take a jeep ride into the Park. After about 15 minutes from the Bisalvadi waterhole, the jeep reached a rivulet amidst a very dense forest tract. While scanning the banks for waders, I observed two large birds, the lesser adjutant-stork *Leptoptilos javanicus* and black stork *Ciconia nigra*. The scarlet red beak and legs of the *C. nigra* were perfectly illuminated by the sun and the white underparts were unmistakable. I observed the birds for a good 15 minutes before returning to the lodge. On mentioning the

sighting to Mr. Sarath, the chief naturalist, Kabini River Lodge, I gathered that though *L. javanicus* had been occasionally sighted, no one had ever come across a *Ciconia nigra,* in spite of a close vigil by many visiting field biologists and naturalists.

Although the lesser adjutant-stork has been sighted in the Western Ghats on several occasions (Anon 1987, Ali 1969, Baker 1935, Jerdon 1839-1840), its true status and movement within the biogeographic zone is not clear. However, reports of its breeding in Periyar Tiger Reserve have confirmed the existence of a small viable population in south India.

According to Ali and Ripley (1987), *C. nigra* is a winter visitor to west Pakistan, north India from Baluchistan, Sind, North West Frontier Province and Punjab through Nepal (to *c.* 900 m alt.) and the Gangetic plain to eastern Assam, south through Rajasthan to about Kutch and northern Gujarat. It is considered to be rare in Deccan, south of *c.* 18° N. (Sholapur district). However, there are sporadic records of the bird from peninsular India, as can be seen from Table 1.

In the light of the above mentioned records, one can safely conclude that, for reasons not yet clear, there seems to be a distinct southward movement of the bird, which a few decades ago was never known to even stray into these areas. Madsen (1988) speculated that this may be due to the severe drought in the north. However, this southward movement may have been forced upon the species by the loss of precious habitat in Pakistan, West, North and Northeastern India (Khachar 1976, Khacher 1986, Himmatsinhji

Table 1
SIGHT RECORDS OF BLACK STORK IN PENINSULAR INDIA

Name of area	District	State	No. of. Storks	Date	Source
Ratapani Wildlife Sanctuary	Bhopal	Madhya Pradesh	NM	6 Mar. 1994	Misra, 1994
Kanha National Park	Mandla	Madhya Pradesh	1	Jan. 1995	Andheria, 1995
Gir Sanctuary	Junagadh	Gujarat	11	NM	Baskaran 1995
Shindovani Lake	Pune	Maharashtra	6	NM	Naik, 1989
Januna Lake	Buldana	Maharashtra	5	Winter 1990	Sawji, 1990
Rollapadu	Kurnool	Andhra Pradesh	2	Nov. 1985	Manakadan, 1988
Rollapadu	Kurnool	Andhra Pradesh	6	Dec. 1985	Manakadan, 1988
Bolarum	Hyderabad	Andhra Pradesh	1	5 Apr. 1987	Kanniah & Ganesh, 1990
Parambikulam Wildlife Sanctuary	Palakkad	Kerala	1	14 Feb. 1984	cf. Neelkantan *et. al.*, 1983
Parambikulam Wildlife Sanctuary	Palakkad	Kerala	1	16 Feb. 1986	cf. Neelkantan
Chamravattom	Malappuram	Kerala	1	7 Jan. 1987	cf. Neelkantan *et. al.*, 1983
Malampuzha reservoir	Palakkad	Kerala	11	16 Feb. 1987	cf. Neelkantan *et. al.*, 1993
Periyar Tiger Reserve	Idukki	Kerala	1	24 Feb. 1987	cf. Neelkantan *et. al.*, 1993
Walayar dam	Palakkad	Kerala	7, 8, 14	12, 16, 25, Jan. 1991 resp.	cf. Neelkantan *et. al.*, 1993
Walayar	Palakkad	Kerala	14	8 Jan. 1994	Praveen, 1997
Near Munnar	Idukki	Kerala	1	4 Feb. 1997	Prasad, 1997
Kaliveli Tank	—	Pondicherry	1	30 Jan. 198 and 5 Feb. 1988	Perennou & Santharam, 1990
Helawe & Bagura plane	Kumana	Sri Lanka	1	20 Mar. 1938	Phillips, 1940
Madangiri Salt Work	Uttar Kannada	Karnataka	3	13 Dec. 1987	Madsen,1988
Gothehalli Village	Belgaum	Karnataka	2	26 Feb. 1994	Sant, 1994

(NM: Not Mentioned)

1985, Pandey 1989, Buckton and Morris 1990, Sivasubramanian 1992, Barman and Talukdar 1995, Gandhi 1995, Barua *et. al.* 1997), where it is known to exist in greater numbers.

There is also a remote possibility of some individuals straying from their normal course during migration to the Subcontinent from Eastern Europe. However, it would be difficult to ascertain this.

Considering these facts, I sincerely appeal to all field biologists and bird watchers to keep a close watch on the movements of the stork, so that we can make a concerted effort at protecting the new emerging haunts of *Ciconia nigra* in South India. Also, we need to step up our efforts to ascertain the true status of *Leptoptilos javanicus* within the Western Ghats range.

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9. LONG-BILLED VULTURE *GYPS INDICUS INDICUS* NESTING ON TREES IN THE THAR DESERT, RAJASTHAN

(*With one plate and one text-figure*)

There are two subspecies of longbilled vultures *Gyps indicus* in the Indian subcontinent, differentiated on the basis of their distribution, nesting habits and physical features. The long-billed vulture (*Gyps indicus indicus*) is distributed south of the Gangetic plain, except extreme southwest India and Ceylon. The Himalayan long-billed vulture (*Gyps indicus tenuirostris*) is found in the Gangetic plain north to and along the lower Himalayas through Nepal, Bengal and Assam, where it is very common and in eastern Assam and Bangladesh (Ali and Ripley 1987).

Nest-site selection is the main behavioural difference between the two subspecies. The long-billed vulture nests on ledges of cliffs and hill forts, while the Himalayan long-billed vulture nests on trees in small colonies (Roberts 1991). The breeding season for both ranges from November to end of February, or latest up to March.

The long-billed vulture has been observed nesting on cliffs in many areas of Rajasthan, while the Himalayan long-billed was reported breeding in Ambala district, Haryana (Jones 1916). When I found five nests of the longbilled in Nagaur district, Rajasthan in May 1994 on *Prosopis cineraria* trees, I assumed that they were nests of the Himalayan long-billed vulture, because the species is already reported from Ambala in the adjoining state of Haryana (Jones 1916) and the nests were on trees. I took some photographs and made notes on the bird and nest (Plate 1, Fig. 1).

I came across another nest of the same bird in December, 1997 near Saanchu in Bikaner, Rajasthan (Fig. 1). The nesting bird was paler and the neck of the subadult was covered with whitish down. The neck of the bird guarding the nest was partially covered with down. One was sitting on the same tree and the other on another tree some 15 m away. The feathers on the legs extended well below the knee joints. The bill and cere had a yellow horn-like colour.

The nest was placed on the highest crotch of a *Prosopis cineraria* tree about 8 m from the ground, and was open from all sides. It measured 68 cm x 90 cm and had a depth of 103 cm. The measurement of only one nest was taken, after the juvenile had left it.

The nest materials were twigs of *Capparis decidua*, *Prosopis cineraria*, *Acacia arabica*, *Brassica campestris* stubble from a nearby field and some pieces of cloth. The tree on which the nest was placed was surrounded at its base by *Capparis decidua*, *Prosopis juliflora* and an unidentified thorny bush which grows to 2 m. All the five nests were on *Prosopis cineraria* trees growing in about one sq. km area.

This subspecies was confirmed by John Schmitt, a bird artist from USA, with the help of a photograph of the longbilled vulture on its nest.

PLATE 1

Kulshreshtha, Manoj: *Gyps indicus*

Fig. 1: Long-billed vulture *Gyps indicus* on a nest in Rajasthan

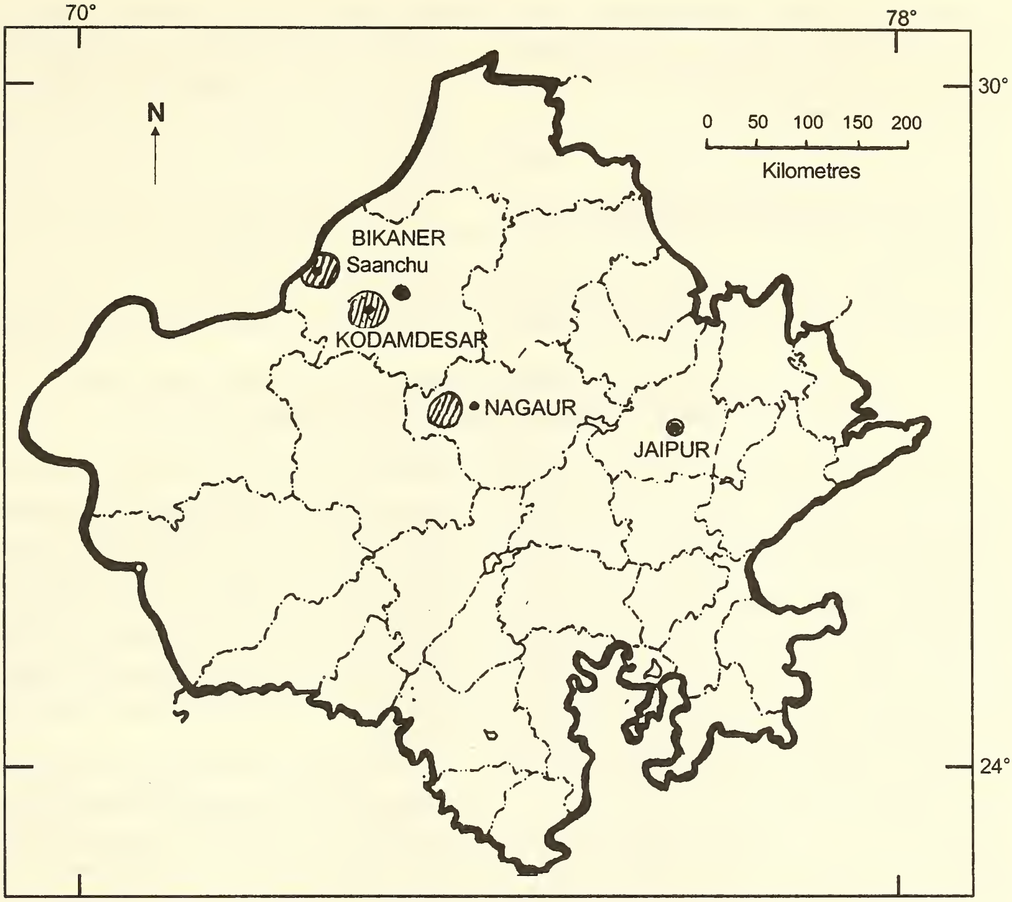

Fig. 1: Map of Rajasthan showing breeding locations of *Gyps indicus indicus* as barred area

These observations are interesting, as there are no breeding records of the Indian long-billed vulture from the Thar desert. Also, this subspecies has never been reported nesting on trees so far. Although Mathews (1918) has once reported long-billed vulture nesting on peepal (*Ficus religiosa*) trees from Lucknow district (Uttar Pradesh), he did not describe the features differentiating the two subspecies and used the Latin name *Gyps indicus*. It is possible that he observed the Himalayan long-billed vulture (*Gyps indicus tenuirostris*) which also breeds in the study area. I hope this information will be useful for birdwatchers interested in raptors and inspire them to examine vulture nests in the desert carefully.

Nesting of long-billed vulture (*Gyps indicus indicus*) on trees has also been sighted by H.S. Sangha and Harshvardhan (*pers. comm.*) on a Khejri tree near Talchhapar Sanctuary in Churu district, and by Rishad Naoroji (*pers. comm.*) in Kodamdesar in Bikaner district.

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10. GREY-HEADED LAPWING *VANELLUS CINEREUS* (BLYTH) (FAMILY CHARADRIIDAE) IN KERALA

The Kole wetland is a vast water body spread over 13,000 ha in Thrissur and Malappuram districts, Kerala. It is located between 10° 20'-10° 40' N and 75° 58'-76° 11' E. The Kole wetland is inundated round the year. During November to February, different parts are under paddy cultivation, which is done after draining off the water into a network of canals throughout the wetland. The water in the fields is brought to the desired level, and one crop of rice is cultivated annually.

On January 28 and 30, 1999, around 1500 hrs we saw a lapwing in Enamavu area in the Kole wetland. Interestingly, it was located in a small patch of about 0.5 ha of uncultivated area, surrounded by paddy, *c.* 3 km off the main road and *c.* 500 m from the mud-topped road used by the farmers. The reason for not planting paddy in this area could not be ascertained.

Among the various species of birds present in the wetland, the 'unidentified lapwing' caught our attention. On closer examination through binoculars, we were able to describe the bird both in the sitting posture and in flight as follows: upper parts, excluding head and neck uniformly brown, head and neck grey with a brown tinge, chin and throat whitish, breast ashy grey, bordered by a black pectoral band across, rest of under parts white. Rump, upper tail coverts and tail white, with a broad black subterminal band. Black band on the tail could be seen when the bird flicked its tail while at rest. Tip of the wings black. Bill bright yellow with black tip, legs yellow, iris red with narrow yellow eye-ring, yellow thickening near the base of the bill seen at close range. The bird was identified as the grey-headed lapwing (*Vanellus cinereus*).

In flight, the white tail with black subterminal band, and black tipped wings with broad white wing bands and a dark pectoral band across the neck are conspicuous. Under primaries were mostly black and rest of underwing white. From a distance, the bird could be confused with white-tailed lapwing (*V. leucurus*), but the black tipped yellow beak, dark pectoral band, and the black subterminal band on the tail distinguished it from the white-tailed lapwing. The grey-headed is also larger than the white-tailed, and also larger than the redwattled lapwing (*V. indicus*).

The bird seemed to be very shy and flew away at the slightest disturbance. As it was about to take off, it made a low pitched, single note *kek*.

The first author had seen a white-tailed lapwing (*V. leucurus*) from Enamavu Kole lands in December 1998. In February and March 1999, grey-headed lapwing was present in a particular

area in this wetland. The sighting of an adult grey-headed lapwing from Kerala assumes significance as Ali and Ripley (1987) give the southern most distribution range as north Bihar. They also state that "a large proportion of our visitors are young birds without pectoral band".

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11. FEEDING HABITS OF THE WHITE-BREASTED KINGFISHER *HALCYON SMYRNENSIS* (LINN.) FAMILY ALCEDINIDAE

The white-breasted kingfisher is well known for its versatile food and feeding habits (Ali and Ripley 1970, Mukherjee 1975, Yahya and Yasmeen 1991, Knowles and Nitchen 1995). However, it was quite interesting to observe three white-breasted kingfishers join a mixed hunting party of insectivores and hunt with them.

On June 18, 1999, I was following a mixed hunting party near Muthanga in Wynaad Wildlife Sanctuary, Kerala (11° 35'-11° 55' N and 76° 02'-76° 27' E). The Sanctuary is dominated by Moist Deciduous Forest with thick bamboo groves at many places. The Muthanga Forest Range of this Sanctuary adjoins the Bandipur (Karnataka) and Mudumalai (Tamil Nadu) National Parks at a place called Trijunction. After good rainfall in the morning, several species of birds were feeding in a teak (*Tectona grandis*) dominated patch of the forest. The party included the greater racket-tailed drongo (*Dicrurus paradiseus*), bronzed drongo (*D. aeneus*) common woodshrike (*Tephrodornis pondicerianus*), Loten's sunbird (*Nectarinia lotenia*), gold-fronted chloropsis (*Chloropsis aurifrons*), white-cheeked barbet (*Megalaima viridis*), scarlet minivet (*Pericrocotus flammeus*), velvet-fronted nuthatch (*Sitta frontalis*), lesser golden-backed woodpecker (*Dinopium benghalense*) and several species of warblers. The birds were moving from one area to another in a typical wave (Yahya 1990) of insectivores. It was still cloudy and windy at 1240 hrs, when I heard the calls of a white-breasted kingfisher among the birds, and on scanning the flock, found that three birds had joined the party.

The kingfishers, perched above and below the teak foliage, made frequent sallies like any other fly-catching bird, and hunted with the party for the next 90 minutes. During this period, they also called frequently. In fact, it was their typical loud calls *kilililia kalililia* ... which first attracted my attention. Initially, I thought the white-breasted kingfisher had just appeared on the scene, and may have some other interest in the area (such as a nest), but their constant following and hunting with the party demonstrated their expertise as insectivores. I have never seen this species following a mixed hunting party before, nor is any such record available in the literature. One of our research scholars, Sajeev T.K, in Anaimalai Hills, also saw this phenomenon recently.

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12. LARGE GREY BABBLER (*TURDOIDES MALCOLMI*) TRAPPED FOR THE TABLE

It was not surprising to find the large grey babbler *Turdoides malcolmi* (Sykes) listed as a bird that needs conservation, in a brochure issued by the Birdwatchers' Society of Andhra Pradesh. The present status of this species, which is described as common in Deccan Plateau, now calls for its conservation. Factors that have contributed to its destruction in Deccan Plateau cannot be analysed here, but one of the major factors, which might have lead to its decline in Chhattisgarh State, is intensive trapping. The large grey babbler is commonly served instead of quail in roadside hotels, as the incident related below will confirm.

One of my junior officers had brought a bagful of quail. Luckily, before his departure, the so-called quail were examined, and to our utmost surprise, they were in fact large grey babblers tied in bunches by the legs. Their tail feathers had been pulled out and wings broken. The birds were photographed and later released into the bush.

Large grey babblers are commonly sold and served as quail, and customers in their ignorance, relish the babblers. No helping hand has come forward to save them.

April 7, 1999

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13. MALABAR WHISTLING-THRUSH *MYIOPHONUS HORSFIELDII* IN THE GIR FORESTS, SAURASHTRA, GUJARAT

A Malabar whistling-thrush *Myiophonus horsfieldii* (Vigors) was seen continuously for a week from April 7 to 15, 1998 in the Gir Forests, Saurashtra. It used to arrive at a spot on the riverbed near Nanava Ness at around 0700 hrs daily, and feed on insects off cow dung, river cliffs, riverbed, dry leaves, humus and on the bark of trees. It was not shy and allowed observers to approach even to about 3 m. When disturbed, it flew away, uttering a low whistle. The thrush was easily identified by its blue black colour, glistening cobalt blue on the forehead and shoulders, and its black bill and legs. The bird was photographed for record.

The northernmost record of the Malabar whistling-thrush is south Rajasthan and its presence in the Gir is an extension of its range into the Saurashtra peninsula. Its occurrence in the dry deciduous forests of the Gir is also an unusual change from the usual habitat of Evergreen and Moist Deciduous Forests.

April 16, 1999

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14. MALE BREEDING PLUMAGE OF THE BAYA WEAVER *PLOCEUS PHILIPPINUS TRAVANCOREENSIS* WHISTLER

The HANDBOOK OF THE BIRDS OF INDIA AND PAKISTAN Vol 10, p 93 (1974) by Sálim Ali and Dillon Ripley, mentions that the male breeding plumage of *Ploceus philippinus travancoreensis* is largely suppressed as in the eastern race *burmanicus* and further investigation is necessary.

During my visit to the British Museum (Natural History), Tring, U.K., I examined the 5 specimens of *travancoreensis* in their collection. The type specimen is a male collected by Sálim Ali on February 19, 1933 from Kottayam, Kerala. The bird was moulting into breeding plumage. The forehead and part of the crown has deep bright yellow feathers and the hind crown, nape and neck still have black feathers. From this observation I presumed that *travancoreensis* males would have bright yellow breeding plumage like the nominate race *philippinus*. I contacted a seasoned birdwatcher Mr. C. Sashikumar from Kerala in July 2000 for a report on the male breeding plumage of *travancoreensis*. He was unsuccessful in obtaining the information due to failed breeding season of the birds in 2000, but he observed 30 nests of *travancoreensis* on coconut trees at Pattanur, Kannur district, Kerala on August 5, 2001. All the males had bright yellow crown, nape and breast, and yellow and brown streaks on the back. The male breeding plumage in *P.p. travancoreensis* is as bright as in *P.p. philippinus* and not suppressed at all.

ACKNOWLEDGEMENTS

I am grateful to Dr. Robert Prys-Jones, Head of Bird Group, British Museum (Natural History), Tring, U.K. who personally handed over the type specimen of *travancoreensis* to me in the absence of the Curator, Mr. Mark Adams. I am indebted to Mr. C. Sashikumar for observing and reporting the breeding plumage of *P.p. travancoreensis*.

November 9, 2001

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15. SIGHTING OF ORTOLAN BUNTING *EMBERIZA HORTULANA* LINN. IN NARAYAN SAROVAR SANCTUARY, KACHCHH, GUJARAT

We saw an Ortolan bunting *Emberiza hortulana* Linn. near Mudia village, and between Sanandro and Khadak villages during a winter avifaunal survey (Nov-Dec 1998) in Narayan Sarovar Sanctuary, Kachchh district. In all, we had five sightings, of which on four occasions only one bird was seen, while on one occasion four birds (1 male and three females) were seen.

The Ortolan bunting is among the most colourful buntings in India, and can be identified easily by the presence of three yellow moustachial stripes on the throat. Of these, one broad stripe runs down the throat, starting from the base of the lower mandible. The other two, one on either side, run backwards from the base of the lower mandible, below the eye, towards the wings. All these stripes terminate within the ashy grey patch which extends from below the throat to the point where the belly starts, and also behind the neck. These stripes are pale yellow in the female bird and bright yellow in the male. The ring around the eye is creamy yellow and the bill bright orange. Only the Ortolan and grey-necked buntings (*Emberiza buchanani*) have the eye ring. The latter has been reported as common and abundant during winter in Kachchh

(Ali 1945, Khacher 1996).

Two solitary birds were seen in a grassy patch next to fallow land in undulating areas, feeding on grass seeds along with the tawny pipit (*Anthus campestris*) and house sparrows (*Passer domesticus*). The other three sightings were in grassy patches on stony hill slopes under *Acacia senegal* forest with *Euphorbia nuvulia*, *Salvadora oleoides* or *S. persica* association. Each time the bird was disturbed, it immediately flew for cover, most often into *Euphorbia* or *Salvadora*.

In India, the Ortolan bunting has been recorded as a vagrant on spring migration, twice in Gilgit, once each in Kashmir and Delhi (Ali and Ripley 1983). It was recorded only once in the Little Rann of Kutch Sanctuary in Kachchh district (Dharmakumarsinhji 1977) and in Hingolgadh in Rajkot district, Gujarat (Khacher 1996).

Extralimitally, it breeds in the western Palaearctic from the Altai and Iran, west to Scandinavia and Spain. It winters from Mediterranean to Senegal and Somalia, Arabia and Iran (Ali and Ripley 1974). This is an additional record for India and only the second one, after more than 20 years, from Kachchh.

June 12, 1999

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16. OCCURRENCE OF *CNEMASPIS KANDIANA* (KELAART), FAMILY GEKKONIDAE, IN AMBOLI, MAHARASHTRA.

On August 8, 2000, while searching for amphibians at about 2230 hrs near an abandoned house in Amboli (15° 55' E, 73° 55' N), Maharashtra, we saw a gecko moving on the wall. Another specimen of the same species was seen in our hotel room the same night. The latter specimen was collected and brought to the BNHS and was identified as *Cnemaspis kandiana* (BNHS Regn. No. 1446). Only two specimens of this species were recorded during this survey. We visited the area again between October 10-12, 2000. During this visit, we sighted a large number of *C. kandiana* in the forest and inside houses. In the forest, they were mostly found on trees, under rocks and among the leaf litter. They frequent houses and were mostly seen on walls. During the day, they were seen basking or chasing each other, and during the night, they were mostly seen feeding on insects attracted towards a light source. *C. kandiana* was the most commonly seen gecko at Amboli among the 29 specimens recorded in two hours in the morning, in the Nature Park, an area of *c.* 1 km patch of forest developed by the Forest Department.

According to Smith (1935), the range of this species is Sri Lanka and the hills of southern

India as far north as 12°. It is also recorded from Thailand (Taylor 1963; Cox *et al.* 1998), Sumatra (De Rooij 1915), the Mentawei Islands (Dring *et al.*, 1990; Smith, 1926) and both the Andaman and Nicobar Islands (Das 1999). In Maharashtra, Humayun Abdulali (1955) had recorded this species (BNHS Regn. No. 70) from Mahabaleshwar (17° 56' E, 73° 42' N) and Yellapur, North Kanara (14° 59' E 74° 46' N). It was also included in the list of reptiles of Maharashtra by Daniel (1974) and the list of turtles and lizards by Nalawade (1998).

Though this is not a range extension of this species, their abundance at Amboli is noteworthy.

We are thankful to Mr. Sameer Kehimkar, who helped us during one of the surveys.

September 3, 2001

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*Original not seen.

17. A NOTE ON THE ECTOPARASITIC TICKS OF REPTILES FROM SOUTHERN RAJASTHAN

Very little is known about ticks that live as parasites on reptiles of southern Rajasthan. Sharma (*JBNHS 94(3)*: 573-55) has reported *Aponomma gervaisi* infesting *Varanus*

Table 1
PARASITIC TICKS COLLECTED FROM REPTILES KILLED ON THE KOTRA-PALIYAKHEDA AND JHADOL-GORANA ROAD

Sl. No.	Locality	Year	Host	Parasitic Tick	Site of Attachment
1.	Jhameri Reserve Forest, Range Jhadol (T)	1994	*Python molurus*	*Amblyomma javanense*	Dorsum
2.	Kirat Reserve Forest, Range Jhadol (T)	1994	*Geochelone elegans*	*A. clypeolatum*	Near tail base
3.	Phulwari Wildlife Sanctuary	1995	*G. elegans*	*A. clypeolatum*	Near base of neck
4.	Phulwari Wildlife Sanctuary	1996	*P. molurus**	*A. javanense*	Near cloaca
5.	Gujari-ki-Nal Forest, Range Jhadol (T)	1997	*P. molurus*	*A. javanense*	Ventrum

*A live specimen was removed from the road and released in a safer locality inside the Sanctuary

bengalensis in Udaipur district, Rajasthan.

To know more about the ticks of reptiles of southern Rajasthan, many reptiles killed on the Kotra Paliyakheda and Jhadol-Gorana road in Udaipur district, Rajasthan were examined and the ticks collected. The samples were sent to the Zoological Survey of India, Kolkata, for identification. Besides *Aponomma gervaisi* on *Varanus bengalensis*, two other species of ticks were also recorded (Table 1).

ACKNOWLEDGEMENT

I thank Dr. A.K. Sanyal, Scientist 'E' and Officer-in-charge, Acarology Section, ZSI, Kolkata for identification of the ticks.

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18. ON THE NATURAL HISTORY OF *BUFO PARIETALIS* BOULENGER, 1882, AMPHIBIA: FAMILY BUFONIDAE

Bufo parietalis was described by Boulenger (1882) from the south Indian state of Kerala. The only record of the species from Karnataka is that of Daniels (1992), who reported one adult from the evergreen forest leaf litter in Charmadi Ghats. This is the first report of populations of the species from Karnataka. We discuss the new range in Pushpagiri Wildlife Sanctuary, Karnataka, its call, habits, food and breeding season.

The Pushpagiri Wildlife Sanctuary in Karnataka (12° 15' N; 75° 33' E) on the western slope of the Western Ghats ranges from 125 m above msl at Subramannya to 1,400 m above msl at Kumaraparvatha. The vegetation is Semi-evergreen with high canopy cover. However, due to selective felling 25 years ago, the forest is secondary. Though there is an annual harvest of cane and other minor forest produce, there are no human settlements within the forest. The day temperature ranges from 26-29 °C and the night temperature at 2000 hrs is around 18 °C in the post monsoon season. The annual monsoon rainfall totals 400 cm. A few showers are received in November and January. This tropical rain forest supports many perennial hill streams with rocky puddles, which are often used by the toad for breeding.

We surveyed the forest for amphibians in 1998-2000 by walking along six well spaced transects. Transects were placed in three altitudinal classes. A total of 21 km were walked in 18 months.

This large, terrestrial and crepuscular forest toad has prominent parotid ridges. The parotid glands are enlarged during the breeding season. The dorsal surface is black, the skin rough and irregularly folded. Supraorbital, postorbital and parietal ridges are contiguous. Ventrally, it is white with dark brown speckles.

Altitudinal preferences: The rainforest toad population was unevenly distributed within the forest and seemed to have altitudinal preferences. In the study area, they were observed to occur between 150 m and 360 m above msl. However, elsewhere in India, they occur at 500 m above msl or more (Daniels 1992).

Morphometrics: The average snout to vent length (SVL) of male toads measured 62.55 mm (N=22) and of females 96.41 mm (N=18). The toad was previously known to reach 85 mm (Daniel 1963), while the largest we recorded was 105.6 mm.

Habits: We observed that the toad goes into dormancy during the peak monsoon months (June to August) and breeds in February (Table 1).

Feeding: The toads were seen catching and eating low flying and crawling insects such as fruitflies (*Drosophila melanogaster*), ants and grasshoppers. The fecal contents revealed

TABLE 1
ACTIVITY PATTERN OF *BUFO PARIETALIS* IN PUSHPAGIRI WILDLIFE SANCTUARY, KARNATAKA

Months	Activity	Time (hrs)
Feb.-Mar.	Calling chorus, aggregation, breeding	1830 to 0545 (Daily)
Apr.-May	Feeding, resting in water	1900 to 2400 (once in 7-10 days)
Jun.-Aug.	Dormancy	—
Sep.-Jan.	Feeding	1840 to 0600 (Daily)

fruitflies as the principal constituent of the diet, along with ants and cockroaches. A 30.5 mm cockroach wing was observed in the excreta of a female toad (105.6 mm SVL).

Calling: During the breeding season, hundreds of male toads called in chorus. The call was loud, harsh and aggressive, and given in series of 11-18. The low tone call resembled that of the pond heron (*Ardeola grayii*) — *kwak kwak kwak kwak*. The number of calls varied from 11-28 per minute.

Breeding: Not much is known of the breeding season of these toads. In Silent Valley, it breeds during December (Daniels 1992). We observed breeding from February to March. More than 200 calling males gather around the puddles of the perennial slow streams that flow under the canopy cover. All the puddles (n=8) measured 2-3 m in width with 30 cm deep clear water, and plenty of decaying vegetation. The water temperature was 28 °C. After the initial calling, amplexus was observed in more than 50 frogs. The amplexus remained for more than 12 hrs, and continued even during the day in the water. A clutch-size of approximately 200 eggs was observed in two cases.

ACKNOWLEDGEMENTS

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March 21, 2001

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19. DISTRIBUTION OF *BUFO STOMATICUS* LÜTKEN, AMPHIBIA: FAMILY BUFONIDAE, IN ASSAM, NORTHEAST INDIA

Bufo stomaticus Lütken (Anura: Bufonidae) is a tropical and subtropical species occurring in a variety of conditions from warm, humid, mixed forests to almost perennially arid, stony places, supporting only scattered shrubs and grasses. However, its abundance is greater in regions experiencing dry and wet seasons supported by a monsoon climate (Auffenberg and Rehman 1997). Lütken originally described *Bufo stomaticus* from Assam (Dutta 1997), but did not specify a locality. Later, it was described as a common species from the Indian subcontinent (Lower Bengal: Annandale 1909; Maharashtra: Yazdani and Mahabal 1976; Himachal Pradesh: Tilak and

Mehta 1977; Gujarat: Sarkar 1984; Orissa: Dutta 1988; Bihar, Karnataka, Jammu & Kashmir: Sekar 1991; West Bengal: Sarkar *et al.* 1992; Andhra Pradesh: Sarkar *et al.* 1993; the Ganga Basin: Chanda 1991; Nepal: Zug and Mitchel 1995; Rajasthan: Sharma 1999). Subsequent investigations have failed to record this species from Assam. A recent review on geographic variation (Auffenberg and Rehman 1997) also did not include specimens from its type locality. This communication deals with the distribution of *Bufo stomaticus* in Assam and its comparison with the geographic variations observed by Auffenberg and Rehman (1997).

The study is based on 17 specimens collected between 1998-2000 from Orang National Park (92° 15'-92° 30' E and 26° 30'-26° 40' N, district Darrang), Kuriahmari (a riverine island of the Brahmaputra, 91° 09'-91° 18' E and 25° 59'-26° 05' N, district Nalbari), Baghbor (90° 55' E and 26° 10' N, district Barpeta) and Balipara Reserve Forest (92° 39'-92° 51' E and 26° 53'-27° 01' N, district Sonitpur). All specimens are housed in the Museum of Arya Vidyapeeth College (KUR 6988-89, BGB 6991-6995, ONP 10-17 and BLP 3008) except two that are registered in ZSI, Kolkata (A9098-99). Specimens were collected by hand and morphometric measurements were taken with dial Vernier calipers. We analysed and performed student t-test for five characters which were:

SVL - Snout vent length

VTYD - Vertical tympanum diameter: greatest vertical diameter

PAL - Parotid gland length: greatest anterio-posterior length of parotid gland

PAW - Parotid gland width: greatest transverse distance of parotid gland.

TL - Tibia length: distance between posteriormost part of tarso-metatarsal to anteriormost part of articulation between tibia and femur.

Bufo stomaticus was found to be abundant in and around human habitation in the districts of Barpeta, Nalbari, Darrang and Sonitpur in Assam. All localities are on the north bank, except Kuriahmari, which is an island in the middle of the River Brahmaputra. No collection/observation could be made on the south bank, despite active searches. It appears that the Brahmaputra acts as a barrier in distribution. The habitat of *B. stomaticus* is moist, thick broadleaf matted grass with occasional scrubs. It was found to be synotopic with the more common *B. melanostictus* in Orang National Park (NP) and Baghbor. However, no *B. melanostictus* could be found in Kuriahmari. Both *B. stomaticus* and *B. melanostictus* were recorded as human commensal, but in Orang NP and Baghbor, *B. stomaticus* seemed to prefer less disturbed areas than *B. melanostictus*. Balipara forms the extreme east of its range of distribution. The species is included in the checklist of Chakrashila Wildlife Sanctuary (95° 15'- 90° 20' E and 26° 15'-26° 26' N, district Dhubri; Datta *et. al.* 1998), but this requires further confirmation from specimens.

As in all bufonid species, the SVL of the female of *Bufo stomaticus* is statistically ($P>0.01$) larger than the males. The proportional length of other characters in male and female do not show significant variation except PAW (Table 1). Our observation is in conformity with that of Mahapatro and Dash (1991), and Auffenberg and Rehman (1997) except for PAW.

The mean value of VTYD standardized against SVL (SVL/VTYD) is 15.62. The Assam set is comparable to Orissa (19.91, Auffenberg

TABLE 1
MORPHOMETRIC MEASUREMENTS (MM) OF MALE AND FEMALE *BUFO STOMATICUS* FROM ASSAM

Parameter	Male	Female
SVL	56.91	67.48
VTYD	3.74	4.07
PAL	15.05	16.70
PAW	9.20	10.68
TL	21.61	24.04

and Rehman 1997) and appears to be a distinct geographic morphocline representing north-eastern India.

The mean value of parotid gland length (PAL) standardized against SVL (SVL/PAL) is 4.00. Auffenberg and Rehman (1997) considered the central Indo-Gangetic-Indus river plains' populations (SVL/PAL 4.17) which represent the average condition with respect to PAL. That the proportionate parotid gland length tends to decrease in all directions from this central area is supported by our observation.

The mean TL standardized with SVL (SVL/TL) is 2.74. There occurs a distinct geographical morphocline from Kumaon Himalayas all along the Gangetic plain where the value gradually decreases. The Assam set value is again different from the populations from central and eastern India.

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20. TAXONOMIC VARIATION IN *SCHISTURA VINCIGUERRAE* (HORA, 1935) FROM THE BASISTHA RIVER, A NEW RECORD FROM ASSAM, INDIA

The hill streams of Assam harbor varied fauna, which has not yet been fully assessed. Several workers have studied the fish fauna of the hill streams of Assam, namely Hora (1935),

Sen (1985) and Menon (1987). The river Basistha (26° 10'-26° 45' N and 90° 30' 92° 55' E) is located near Guwahati at an altitude of 80 m above msl. The river originates from Meghalaya and enters Assam near the Basistha temple.

S. vinciguerrae was first recorded by Hora (1935) from S. Shan State, Myanmar. Menon (1987) reported this species from Manipur. Das and Bordoloi (1997) recorded it from the Basistha river, Assam. The present paper gives a taxonomic description based on fifteen specimens collected from this river during 1997-2000. Differences from the earlier descriptions have been discussed.

Specimens were collected from the intermediate zone of the river and were preserved in 8% formalin. Live coloration was recorded before preservation. Description was compared with that in Talwar and Jhingran (1991) and Jayaram (1999). It was confirmed at the Zoological Survey of India, Shillong. All measurements are in mm.

Description: Body marked with several vertical bands. Band anterior to the dorsal fin broken up into a number of narrow bands. Three to four complete bands up to base of caudal fin. Well-marked short prominent vertical band at base of caudal fin and two V-shaped bands at forked end of caudal fin. Dorsal fin with one or two rows of spots, anal and pelvic fins with one row each. Live specimens show pink coloration on the tips of barbels, dorsal fin, anal fin, pectoral fin, and pelvic and caudal fins from April to October. The colour disappears gradually after the breeding season and on preservation.

The size range recorded during the present investigation was 48 to 60 mm (standard length). Detailed body measurements are given in Table 1. Body elongated and sub cylindrical: Dorsal profile is slightly sagging, but ventral surface is

TABLE 1
MORPHOMETRIC MEASUREMENTS OF *NEMACHEILUS VINCIGUERRAE* (HORA, 1935)
FROM THE BASISTHA RIVER, ASSAM

	Specimen number															Range		Mean
Character (in mm)	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	Min.	Max.	(X)
Total Length (TL)	73	73	73	70	67	67	66	65	64	64	62	62	62	60	60	60	73	65.86
Standard Length (SL)	60	60	60	57	54	54	54	53	53	52	49	50	50	48	48	48	60	53.46
Fork Length (FL)	68	68	67	65	61	61	62	60	59	59	55	57	57	56	55	55	68	60.66
Length of Head	14	13	13	13	12	12	13	12	12	12	11	12	12	11	12	11	13	11.4
Head Depth	7	8	8	7	7	6	7	7	7	7	6	7	6	6	6	6	8	6.8
Head Width	11	10	9	9	8	9	9	9	9	8	7	8	8	8	8	7	11	8.66
Depth of Body	11	13	10	9	9	11	9	10	10	9	8	9	8	9	8	8	13	9.53
Length of Caudal Peduncle	9	9	9	8	8	8	8	8	8	9	8	8	7	7	7	7	9	7.93
Depth of Caudal Peduncle	8	7	7	7	6	6	7	6	6	6	6	6	6	6	6	6	8	6.4
Eye Diameter	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2			2.0
Snout Length	7	7	6	6	6	5	6	6	6	6	5	6	6	6	6	5	7	6.0
Post-Orbital Length	7	7	6	7	6	7	7	7	7	6	5	6	6	6	6	5	7	6.4
Pre-Dorsal Length	30	30	30	28	27	27	27	26	26	26	24	25	25	24	24	24	30	26.6
Pre-Pelvic Distance	33	32	32	30	29	28	29	29	30	28	26	28	27	26	26	26	30	28.86
Pectoral Fin Length	13	12	12	12	12	10	12	11	11	12	11	13	11	11	10	10	13	11.53
Pelvic Fin Length	12	11	11	10	11	9	11	10	10	10	9	11	10	10	10	9	12	10.33
Anal Fin Length	11	10	10	10	9	9	10	8	9	9	9	10	9	9	9	8	11	9.4
Dorsal Fin Length	13	12	12	12	12	12	11	12	12	12	11	13	10	12	11	11	13	11.8

at the same level as the rounded belly. Range in total length was 60 to 73 mm. Body depth was 4.6-6.33 in standard length. Head depressed. Head length 4.0 - 4.5 in standard length. Eyes small, placed high up and not visible from the under side of the head. Eye diameter 5.9-6.5 in head length. Nostrils close to each other. Mouth semicircular, lips moderately fleshy, upper lip faintly notched and lower lip interrupted in the middle. Well developed maxillary, rostral and mandibular barbels.

Caudal fin forked, both the lobes equal but the upper lobe sometimes slightly more slender than the lower lobe. Caudal peduncle 5.77-7.14 in standard length. Height of caudal peduncle 7.50-9.00 in standard length. Lateral line complete.

Schistura vinciguerrae (Hora 1935) was earlier known as *Nemacheilus vinciguerrae*. The type locality reported by Hora was S. Shan State, Burma (presently Myanmar). In India, the species was first recorded by Menon (1987) from Chindwin drainage, Irrawaddy and Salween river basins in Manipur. The present record extends the range of this fish westward to Guwahati in Kamrup District, Assam. Distinguishing characters mentioned in Talwar and Jhingran (1999) were Diii 8; Aii 5; Pi 11; Vi 6. These characters were found to be Dii 8; Aii 5; Pi 9-11; Vi 5-6 in the present investigation. A slight variation was also noted in the length of caudal peduncle, which was 5.77-7.14 in standard length as compared to 6.1-6.8 recorded by earlier workers. Similarly, height of the caudal peduncle was found to be 7.5-9.0 in standard length instead of 7.7-8.8 recorded earlier.

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21. ON *PSEUDOSPHROMENUS* SP. (PISCES: BELONTIIDAE) FROM SOUTH INDIA WITH REMARKS ON THE AUTHORSHIP OF *P. DAYI*

The genus *Pseudosphromenus* is of ichthyological significance since it includes two species, *P. cupanus* and *P. dayi*, which are confined to the Indian subcontinent, the former occurring in peninsular India and Sri Lanka, and the latter restricted to Kerala. *P. cupanus* was described by Cuvier and Valenciennes in 1831 from Arian Coupam, Pondicherry on the east

coast, while Day in 1865 distinguished *dayi* from among specimens of *cupanus* from Kerala, based on a specimen having a different colour pattern, one spine less on the dorsal fin and one ray less in the anal fins. Later, Kohler (1908) proposed the name *P. cupanus* var. *dayi* to accommodate this species, which he considered a variety of *cupanus*. Though endemic to Kerala and a popular aquarium fish, there has been no uniformity of opinion on the taxonomic status of this species. Thus, it was overlooked by Jayaram (1981) and considered a synonym of *P. cupanus* by Talwar and Jhingran (1991). Menon (1999) based on authentic reports by aquarists, placed it as a distinct species in his CHECKLIST OF THE FRESH WATER FISHES OF INDIA. In his recent book, Jayaram (1999) also remarks that it is considered a separate species by aquarists.

The two species were collected during faunistic surveys by teams of the Zoological Survey of India. *P. cupanus* was collected from both the eastern (Pondicherry) and western (Kerala) regions and *P. dayi* from Trivandrum, Kerala. A comparative study was carried out to observe intraspecific variations, if any, in *cupanus* from the eastern and western regions and also to ascertain further distinguishing characters of *dayi*.

Morphometric characters were taken with dial calipers with an accuracy of 0.02 mm. The body proportions are given in Table 1 with the mean followed by the range in parentheses.

The following materials were examined.

P. dayi: 10 exs., 18-22 mm SL, F. 5529 ZSI/SRS, Poikat, Varkala, Trivandrum district, Kerala, 3.iv.1998, P.T. Cherian and party.

P. cupanus: 10 exs. 24-37 mm SL, F. 5528, ZSI/SRS, Poikat, Varkala, Trivandrum district, Kerala, 3.iv.1998, P.T. Cherian and party; 7 exs., 23-31 mm SL, F. 3945, ZSI/SRS, Kakayanthope, Pondicherry, Tamil Nadu, 19.iii.1992, K. Ramachandra Rao.

Meristic details: *P. dayi*: from Kerala: D. XIII-XV /5; P.10; V.1/5; A.XVII-XVIII /10; C. 13; L.1. 26-28; L.tr. 10-11; predorsal scales 18-20.

P. cupanus: from Kerala: D.XIII-XIV /6; P.10-12; V. 1/5; A. XVII-XVIII /11; C. 13; L.1.

TABLE 1

COMPARISON OF BODY PROPORTIONS OF *PSEUDOSPHROMENUS* SPECIES

	P. dayi	*P. cupanus* (From Trivandrum)	*P. cupanus* (From Pondicherry)
SL/HL	2.84 (2.72-3.00)	2.97 (2.71-3.41)	2.93 (2.75-3.09)
SL/BD	3.27 (3.07-3.43)	3.10 (2.78-3.51)	2.87 (2.75-2.95)
SL/Predorsal distance	2.12 (2.01-2.27)	2.20 (2.07-2.53)	2.06 (1.98-2.17)
SL/Postdorsal distance	1.82(1.73-2.11)	1.81(1.71-2.10)	1.93(1.81-2.42)
SL/Pre Pelvic distance	2.62 (2.50-2.79)	2.64 (2.42-3.08)	2.67 (2.55-2.75)
SL/Lt. of Pectoral fin	4.38 (4.00-5.21)	4.50 (4.15-5.14)	4.17 (3.91-4.57)
SL/Lt. of Pelvic fin	3.96(3.33-4.46)	4.08(3.59-4.49)	3.67(3.09-4.42)
SL/Lt. of Anal fin	6.23 (5.44-6.90)	5.99 (5.24-6.67)	6.35 (5.65-7.00)
SL/Lt. of Caudal fin	2.55 (1.99-2.97)	2.49 (1.70-3.00)	2.92 (2.82-3.14)
HL/ED	3.31 (2.87-3.37)	3.75 (3.48-4.27)	3.41 (3.18-3.68)
HL/Snout length	4.38 (4.06-4.66)	3.98 (3.48-4.14)	4.37 (4.21-4.70)
HL/I.O.W.	3.67 (3.47-3.89)	3.65 (3.47-3.98)	3.45 (3.08-3.60)
Snout/ED	0.74 (0.64-0.82)	0.94 (0.87-1.12)	0.78 (0.66-0.84)
I.O.W./Ed	0.88 (0.77-0.97)	1.03 (0.92-1.14)	1.09 (0.92-1.71)
BD/Width of body	1.72 (1.64-1.84)	1.86 (1.73-1.97)	1.94 (1.86-2.03)
BD/Ht. of dorsal fin	1.64 (1.21-1.83)	1.62 (1.27-1.98)	1.82 (1.71-1.95)
HL/Lt. of pectoral fin	1.54 (1.40-1.76)	1.51 (1.44-1.61)	1.42 (1.30-1.56)
Lt. of Caudal fin/HL	1.14 (0.81-1.43)	1.21 (0.99-1.66)	1.01 (0.87-1.07)
Anal fin base/Dorsal fin base	1.22 (1.13-1.33)	1.21 (1.13-1.33)	1.34 (1.24-1.44)

SL = standard length; HL = head length; BD = body depth; Lt. = length; ED = eye diameter; IOW = inter orbital width; Ht. = height.

27-31; L.tr. 10-12; Predorsal scales 18-20.

P. cupanus: from Tamil Nadu: D.XIII-XIV /6; P.10-11; V. 1/5; A.XVIII-XIX /10-11; C.13; L.1. 29-30; L.tr. 11-12; Predorsal scales 18-20.

A comparison of the meristic characters of *P. dayi* and *P. cupanus* shows little difference, but for the lesser number of branched soft rays of dorsal (5 vs. 6) and anal fins (10 vs. 11) in *dayi* (Day op. cit). However, in two specimens of *cupanus,* the branched rays numbered 10. Other differences observed are given below.

Apart from its characteristic colour markings, *dayi* is a smaller species with a larger head and eye and a rounded body. The *cupanus* from the east coast has a much deeper and more compressed body with smaller caudal and larger paired fins than in the population from the east coast (Table 1). Also, the predorsal distance is slightly greater in *cupanus* from the east coast, the dorsal originating further back. Besides, in this *cupanus* from Pondicherry, the inter-orbital width is narrower, the eyes being placed closer together on a more compressed head, whereas in the specimens from Kerala the inter-orbital width is more and the head is broader (Table 1). Another interesting feature is the difference in the relative width of the maxilla, which is very narrow in *dayi*. Difference in width of maxilla was observed within the *cupanus* species. In two specimens dissected, one with a broader and another with a narrower lip, the former turned out to be a male. Besides, the specimens of both the species from Kerala were darker than *cupanus* from Tamil Nadu, in keeping with the thick canopy-covered darker waters of the west, in contrast to the bright sunlit waters of the plains in the east.

The authorship of *P. dayi* has been much debated. According to Kottelat (1994), "Engmann (1909) is therefore technically author of the name *Polyacanthus cupanus* var. *dayi* as he is responsible for the conditions which make it available" However, Engmann (1909), while referring to Kohler's recommendation to name the species *P. dayi*, stated that he preferred to call it "*Polyacanthus cupanus* var. *von Malakka*", awaiting reports of examination of the specimens by scientists. Besides, he considered *dayi* a junior synonym of *cupanus*. Hence, by no stretch of the imagination can Engmann be considered technically the author of the name *P. cupanus* var. *dayi*.

Kohler (1908) while reporting the species considered it a variety of *P. cupanus*. Referring to its first description of *P. cupanus* by Day (1865), he recommended the varietal name *dayi*. Since Day's original description of the species adequately distinguishes it from others, especially its closest relative *cupanus*, Kohler's naming the species (which Day had not done) calling attention to the description of the species by Day, validates the naming, and Kohler technically the author of the species name *dayi*. There are many instances in taxonomic literature where only one or two differences in the characters of a described species are given to separate a related species or its variety and giving it a new name which has remained valid through the years. In this instance, the author's name has been resolved as valid since the species was first named, the merits or demerits of subsequent discussions by later authors on the subject are not mentioned.

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22. THE FISH FAUNA OF BHARATHAPUZHA RIVER, KERALA

In Kerala, 44 rivers and an elaborate network of their tributaries harbour a rich and diverse fish fauna. Ichthyofaunal investigations in Kerala, which began with the outstanding works of Jerdon (1849) and Day (1865, 1878), were followed by several other researchers (Pillay 1929, Mukerji 1931, Hora and Law 1941, Hora and Nair 1941, Hora 1942, Silas 1950, 1951, 1952, Rajan 1955, Rema Devi and Indra 1986, Shaji and Easa 1995, Shaji *et al.* 1995, Easa and Shaji 1996, 1997, Biju *et al.* 1999a, b). Yet, the fish diversity in the larger rivers of Kerala remains to be investigated in detail.

Bharathapuzha (Nila) is the longest river in Kerala and the second largest on the southwest coast of India. There are no records of the fish diversity of this river, which is currently under severe ecological degradation due to human impacts. This paper documents the diversity and status of fish fauna of this river system.

The Bharathapuzha river originates from the Anamalai Hills in the Western Ghats at 1,964 m above msl, and flows through Coimbatore district, Tamil Nadu, and Palakkad, Malappuram and Thrissur districts, Kerala and finally meets the Arabian Sea at Ponnani. In Kerala, it has a total length of 209 km and a basin area of 4,400 sq. km (CWRDM 1991). Its main tributaries are the Gayatripuzha, Chitturpuzha (Kannadipuzha or Amaravathipuzha), Kalpathipuzha and Thuthapuzha. From the confluence of Kalpathipuzha and Chitturpuzha at Parali, the river is named Bharathapuzha.

The river basin can be divided into three physiographic zones: the coastal belt, the midland and the highland. The fish survey was conducted in the midland zone. The undulating midland with laterite formation is characterised by a number of *elas* or small, cultivated watershed areas. A number of low laterite hills in this region are interspersed with paddy fields, coconut and areca nut groves and of late, with plantations of cash crops (CWRDM 1991).

Fish samples were collected from March 1997 to March 1999, from different locations in the midland region of the river from Parali to Thirunavaya using cast nets, scoop nets and gill nets of varying mesh size. Conventional methods such as sieving through cloth were also used. Uniform fishing efforts were maintained at all the stations and similar types of nets were employed. The pigmentation was recorded in fresh fishes, which were then fixed in 5% formalin. The works of Day (1865, 1878), Jayaram (1981), Fischer and Bianchi (1984) and Talwar and Jhingran (1991) were referred for identification. The species were categorised into rare, very rare and abundant, based on the catch data.

Sixty-one species of fishes, belonging to 11 orders, 30 families and 50 genera were recorded for the first time from the Bharathapuzha river (Table 1). The results show that despite extensive environmental degradation such as sand mining, rock blasting, pollution and siltation, the river has rich and diverse fish resources.

Of the 61 fish species recorded, *Batasio travancoria* and *Tetraodon travancoricus* are endemic to Kerala, while *Corica soborna*, *Chela dadyburjori* and *Lepidocephalus guntea* are new records. *Barilius bendelisis* was reported to occur widely except in Kerala (Talwar and Jhingran 1991). This study confirms its presence in the State. Among the 61 species of fish collected, 24.59% are very rare while 31.15 % are rare.

Anguilla bengalensis bengalensis, *Batasio travancoria*, *Hypselobarbus curmuca*, *Mystus malabaricus* and *Tetraodon travancoricus* are endangered, and *Puntius sarana subnasutus*, *Tor khudree*, *Heteropneustes fossilis*, *Mystus montanus*, *Anabas testudineus*, *Parambassis thomassi* and *Macrognathus guentheri* are vulnerable, according to IUCN criteria (Molur and Walker 1998).

The major Indian carps *Catla catla*, *Labeo rohita* and *Cirrhinus mrigala*, and *Labeo fimbriatus* cultivated in the Malampuzha dam located in the upper reaches of the river, escaped to the lower reaches, have established good populations there. Similarly, the presence of a larger number of exotic fish such as *Oreochromis mossambica* in the river is a matter of concern to the native fish stock.

Species such as *Megalops cyprinoides*, *Chanos chanos*, *Microphis cuncalus*, *Ambassis commersoni*, *Terapon jarbua*, *Megalopsis cordyla*, *Leiognathus guentheri*, *Lutjanus argentimaculatus*, *Gerres filamentosus*, *Scatophagus argus*, *Liza tade*, *Glossogobius giuris*, *Cynoglossus macrostomus* and *Euryglossa orientalis* are primarily estuarine fishes collected from the freshwater regions of the river. Of these, *Gerres filamentosus*, *Glossogobius giuris*, *Lutjanus argentimaculatus* and *Megalopsis cordyla* migrate from the saline waters to about 85 km upstream and were collected from Lakkidi region.

Studies are warranted to realise the impact of check-dams on the migration of fishes, as more check-dams are coming up in the river. Both *Anguilla bengalensis bengalensis* and *A. bicolor bicolor* are catadromous and the adult eels probably migrate to the deep ocean for spawning; the returning glass eels (larvae) and elvers (young ones) try to migrate far upstream where they grow for many years (Wickstrom *pers. comm.*). Considerable reduction in the population of eels indicates the need to study the impact of check-dams. Further, installing a suitable kind of eel ladder at every dam in the river is also indicated.

Flow regulation by means of check-dams, pollution (mainly agricultural and sewage), sand and clay mining, destruction of natural pools and unscientific fishing methods are the major threats to fish fauna in the river. Some conservation measures are suggested to preserve the ichthyofauna.

1. Fishing by poisoning and dynamiting should be banned.

2. The existing natural pools, which are the breeding centres of the fishes should be protected from fishing. Fish sanctuaries or aquatic biodiversity management zones could be set up.

3. There should be measures to control the pollution of the river, especially from agricultural sources.

4. Regulation of mesh size of nets to prevent large-scale death of juvenile fish in the nets.

5. Assessment of the population density and habitat requirements of fishes in the river.

6. Detailed investigations on the impact of check-dams on the natural migration of the fishes.

7. Assessment of extent of damage done by the increasing population of exotic species to the indigenous stock of the river.

TABLE 1

LIST OF FISHES COLLECTED FROM BHARATHAPUZHA RIVER, KERALA

	Species	Status
	Order: ELOPIFORMES	
	Family: MEGALOPIDAE	
1.	*Megalops cyprinoides* (Broussonet)	VR
	Order: ANGUILLIFORMES	
	Family: ANGUILLIDAE	
2.	*Anguilla bengalensis bengalensis* (Gray)	VR
3.	*A. bicolor bicolor* McClelland	R
	Order: CLUPEIFORMES	
	Family: CLUPEIDAE	
4.	*Corica soborna* (Hamilton-Buchanan)	R
	Order: GONORHYNCHIFORMES	
	Family: CHANIDAE	
5.	*Chanos chanos* (Forsskal)	VR
	Order: CYPRINIFORMES	
	Family: CYPRINIDAE	
	Subfamily: Cyprininae	
6.	*Catla catla* (Hamilton-Buchanan)	A
7.	*Cirrhinus mrigala mrigala* (Hamilton-Buchanan)	R
8.	*Hypselobarbus curmuca* (Day)	VR
9.	*Labeo fimbriatus* (Bloch)	R
10.	*L. rohita* (Hamilton-Buchanan)	R
11.	*Puntius amphibius* (Valenciennes)	A
12.	*P. filamentosus* (Valenciennes)	A
13.	*P. parrah* (Day)	A
14.	*P. sarana subnasutus* (Valenciennes)	A
15.	*P. ticto* (Hamilton-Buchanan)	R
16.	*P. vittatus* (Day)	A
17.	*Tor khudree* (Sykes)	VR
	Subfamily: Cultrinae	
18.	*Chela dadyburjori* Menon	R
19.	*Salmostoma boopis* (Day)	R
	Subfamily: Rasborinae	
20.	*Amblypharyngodon microlepis* (Bleeker)	A
21.	*Barilius bendelisis* (Hamilton-Buchanan)	A
22.	*Danio malabaricus* (Jerdon)	A
23.	*Esomus danricus* (Hamilton-Buchanan)	A
24.	*Parluciosoma daniconius* (Hamilton-Buchanan)	A
	Subfamily: Garrinae	
25.	*Garra mullya* (Sykes)	A
	Family: COBITIDAE	
26.	*Lepidocephalus guntea* (Hamilton-Buchanan)	A

LIST OF FISHES COLLECTED FROM BHARATHAPUZHA RIVER, KERALA

	Species	Status
	Order: SILURIFORMES	
	Family: BAGRIDAE	
27.	*Batasio travancoria* Hora & Law	VR
28.	*Mystus cavasius* (Hamilton-Buchanan)	A
29.	*M. malabaricus* (Jerdon)	R
30.	*M. montanus* (Jerdon)	A
31.	*M. oculatus* (Valenciennes)	A
	Family: SILURIDAE	
32.	*Ompok bimaculatus* (Bloch)	R
33.	*Wallago attu* (Schneider)	A
	Family: HETEROPNEUSTIDAE	
34.	*Heteropneustes fossilis* (Bloch)	R
	Order: CYPRINODONTIFORMES	
	Family: HEMIRAMPHIDAE	
35.	*Hyporhampus limbatus* (Valenciennes)	A
	Family: BELONIDAE	
36.	*Xenentodon cancila* (Hamilton-Buchanan)	A
	Family: APLOCHEILIDAE	
37.	*Aplocheilus lineatus* (Arnold)	A
	Order: SYNGNATHIFORMES	
	Family: SYNGNATHIDAE	
38.	*Microphis cuncalus* (Hamilton-Buchanan)	VR
	Order: PERCIFORMES	
	Family: AMBASSIDAE	
39.	*Ambassis commersoni* Cuvier	VR
40.	*Parambassis thomassi* (Day)	A
	Family: TERAPONIDAE	
41.	*Terapon jarbua* (Forsskal)	VR
	Family: CARANGIDAE	
42.	*Megalopsis cordyla* (Linnaeus)	R
	Family: LEIOGNATHIDAE	
43.	*Leiognathus blochii* (Valenciennes)	VR
	Family: LUTJANIDAE	
44.	*Lutjanus argentimaculatus* (Forsskal)	R
	Family: GERREIDAE	
45.	*Gerres filamentosus* (Cuvier)	R
	Family: SCATOPHAGIDAE	
46.	*Scatophagus argus* (Linnaeus)	VR

TABLE 1 (CONTD.)
LIST OF FISHES COLLECTED FROM BHARATHAPUZHA RIVER, KERALA

	Species	Status
	Family: CICHLIDAE	
47.	*Etroplus maculatus* (Bloch)	A
48.	*E. suratensis* (Bloch)	A
49.	*Oreochromis mossambica* (Peters)	A
	Family: MUGILIDAE	
50.	*Liza tade* (Forsskal)	VR
	Family: GOBIIDAE	
51.	*Awaous gutum* (Hamilton-Buchanan)	A
52.	*Glossogobius giuris* (Hamilton-Buchanan)	R
53.	*Sicyopterus griseus* (Day)	VR
	Family: ELEOTRIDIDAE	
54.	*Eleotris* sp.	VR
	Family: ANABANTIDAE	
55.	*Anabas testudineus* (Bloch)	R
	Family: CHANNIDAE	
56.	*Channa marulius* (Hamilton-Buchanan)	R
	Family: MASTACEMBELIDAE	
57.	*Macrognathus guentheri* (Day)	A
58.	*Mastacembeles armatus* (Lacepede)	A
	Order: PLEURONECTIFORMES	
	Family: CYNOGLOSSIDAE	
59.	*Cynoglossus macrostomus* Norman	VR
	Family: SOLEIDAE	
60.	*Euryglossa orientalis* (Bloch & Schneider)	R
	Order: TETRAODONTIFORMES	
	Family: TETRAODONTIDAE	
61.	*Tetraodon travancoricus* Hora & Nair	R

A = abundant; VR = very rare; R = rare

8. Fishing at the onset of monsoon, the breeding season, should be controlled.

9. Biodiversity monitoring and awareness programmes highlighting the need to protect the river and its biodiversity for the inhabitants of over 140 villages in the river basin.

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23. OCCURRENCE OF CHILLI GALL MIDGE, *ASPHONDYLIA CAPSICI* BARNES (CECIDOMYIIDAE: DIPTERA) IN SOUTH ANDAMANS, ANDAMAN ISLANDS

The chilli gall midge, *Asphondylia capsici* Barnes is a serious pest of chillies and bell pepper, with the potential to reduce the yield by infesting fruiting parts. Ayyanna and Raghavaiah (1990) reported the occurrence of this pest on chillies at Bapatla, Andhra Pradesh, leading to deformation of the flower buds and bud-drop to the extent of 6.5%.

During 1998 and 1999, from September-January, we noticed the pest on the bell pepper grown in our experimental plots. Damage of up to 28 % was recorded. The attacked flowers malformed into galls, dried up and dropped to the ground. The infected flowers when dissected showed pale orange maggots 3 mm long. The malformed buds were incubated in plastic containers over sand to facilitate pupation and emergence of adult *A. capsici*. The adult midge was dark, reddish-brown, mosquito-like, measuring 3 mm in length. During the course of rearing, two unidentified hymenopterous parasitoids were also obtained, which had parasitized the larvae and pupae. Tomar *et. al.*, (1997) reported *Eurytoma* sp., *Dinarmus* sp. and *Bracon* sp. parasitizing *A. capsici* larvae and pupae.

This is the first report of the pest from Andaman Islands.

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24. OVERWINTERING POPULATION OF *DANAUS* (*SALATHURA*) *GENUTIA* IN TIGER VALLEY IN SANJAY GANDHI NATIONAL PARK, MUMBAI, MAHARASHTRA

(*With one text-figure*)

Many species of butterflies migrate from cold temperate regions of the northern latitude to warmer regions during fall, and move north during spring (Williams 1930). The Monarch butterfly (*Danaus plexippus*) of North America is one of the best studied for its migratory behavior (Urquhart 1976, 1978; Urquhart and Urquhart 1979; Brower 1995). Mark, Release and Recapture (MRR) studies showed that the migrating Monarchs reached Sierra Madre Occidentale mountains in Northern Mexico where they hibernate in millions. At the onset of spring they move northwards and lay eggs on milkweed plants in the southern USA. The next generation from these eggs moves to breed further north (Brower 1995).

Most of the butterflies from the northeastern North America overwinter in Sierra Madre Occidentale and Alpha in Mexico. But the populations west of the Rockies congregate in huge numbers on the West Coast in California, in places such as the Monterey Peninsula. Urquhart (1965) defined two types of colonies in California, a transient roosting colony of short duration and a long-term roosting colony. Individuals of short term roosting colonies leave the roosting site under suitable conditions to take nourishment, but do not come back to the same site, while long-term roosting colonies stay in the roosting sites for a long period of time. Unlike some hibernating organisms that do not move, overwintering butterflies are free flying individuals in reproductive diapause, although some females may be gravid (Ackery and Vane-Wright 1984). Some species congregate at overnight roosting sites, particularly in cold and windy weather. This is defined as nocturnal, communal or gregarious roosting behaviour (Ackery and Vane-Wright 1984). Such butterflies leave the site in the morning and may not return to the same spot the next day. Migration of the Danainae butterflies, especially *Tirumala*, *Euploea*, *Danaus* and *Parantica*, has also been recorded in India and elsewhere in south and southeast Asia (Williams 1930; Chaturvedi 1998 and references therein). Other observers at the beginning of the 20th century have described gregarious or nocturnal roosting behaviour for *Tirumala hamata* in Queensland, Australia (McNeill 1937), *Tirumala petivarana* in E. Africa (Poulton 1934), and *Danaus genutia* in Hongkong (Kershaw 1905-1907). Although migration of danaids has been described in India, it was presumed that the migratory population dispersed with the local population. Also, there was no evidence of overwintering populations.

On March 3, 1992, in the company of Ulhas Paralkar, Amar Mehta, and others in the Sanjay Gandhi National Park, near Tulsi dam, in Mumbai, Maharashtra, I came upon a huge congregation of Common Tiger *Danaus* (*Salathura*) *genutia* butterflies, near the water filtration system outlet between the pipelines. As we approached, the butterflies resting on the ferns and bamboo clumps were disturbed and flew all around us in a thick cloud. This location will now

be referred to as Tiger Valley. Observations within about 300 m along the stream suggested that males were more common than females. We had no net to facilitate marking, but took photographs and noted whether they were moving in any particular direction. As it was late on a hot afternoon, most of the butterflies were resting, and when disturbed they would fly around for a very short time before settling back on the leaves, twigs or elsewhere. Bamboo clumps accommodated larger numbers and as many as 32 were seen at one time on a bamboo shaft about 1 cm thick and 1 m tall. I estimated more than 30,000 butterflies at that site. We decided to return to the Valley the subsequent week, to determine if the butterflies were still there and if so to carry out Mark, Release and Recapture (MRR) studies.

During the next few weeks, Ulhas Paralkar, Amar Mehta and I returned on weekends to Tiger Valley between March and July 1991, to conduct MRR studies. We made 11 trips during this study period. The markings were carried out around 1100 hrs to 1300 hrs. We painted the butterflies with either different coloured paints or nail polish (white or blue oil paints and pink nail polish), preferably on both the hind-wings, as these can be seen easily even when the butterfly is resting. On each occasion we marked them with a different colour, so that the area of marking and colour code was unique for a given date. When a marked butterfly was recovered, we marked it again with the day's code to determine the recovery number. During initial releases, we noted the direction in which they flew off. Later we discontinued this recording, as there was no particular directional flight. The condition of each butterfly was also noted.

TABLE 1
THE RESULTS OF MRR STUDIES OF *D. GENUTIA* IN SANJAY GANDHI NATIONAL PARK, MUMBAI

Date of marking	Captured Males	Captured Females	Recoveries
8.iii.1992	0	0	-
15.iii.1992	76	29	0
5.iv.1992	32	52	0
25.iv.1992	49	47	0
3.v.1992	27	42	5
10.v.1992	59	77	3
24.v.1992	58	48	7
31.v.1992	22	40	3
7.vi.1992	29	44	9
14.vi.1992	21	74	8
26.vii.1992	0	0	0
	373	453	

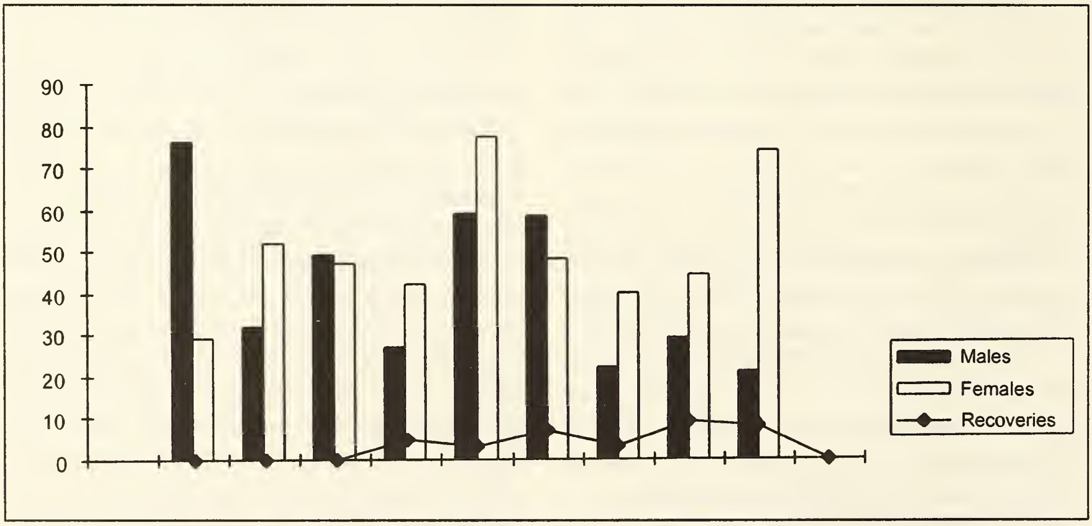

Fig. 1: Results of MRR studies of *Danaus genutia* in Tiger Valley, Sanjay Gandhi National Park

A total of 826 butterflies were marked, of which 373 were males and 453 females. 35 butterflies were recaptured, of which two were recaptured twice (Table 1, Fig. 1). During the first two weeks, none were recaptured. Most of the recoveries were after 7 to 21 days after the day of marking. Seven butterflies were recovered after 35 days. One individual was recorded after 49 days and again 63 days later (Table 2). We captured significantly higher number of females than the males except on the first day when we captured more males (Wilcoxon's paired rank test $t = 2.547, p =<0.01$). Initially the butterflies were in fair condition, but by May and June the females in particular seemed worn out. We also observed that most of the males captured during the last two weeks of June looked newly emerged or fresh. Fifteen marked butterflies were also observed in the area, but could not be caught as they were in an inaccessible area. On our last visit on July 26, 1992, no butterflies remained in Tiger Valley.

We arrived at the study location in the afternoons, as we had to walk at least 7 km to reach it. At this time, the butterflies were mainly resting. We also observed courtship display and several mating pairs. A few butterflies were observed feeding on moist earth, particularly after the burning of the undergrowth in June. Only one tree *Wrightia tinctoria* was flowering during the first week of April. Several Danainae were seen feeding on its blossoms. About 500 m away, near the overflow of the dam there were patches of *Heliotropium indicum* where a few Common Tigers were also seen feeding, but no marked individuals were observed in these patches.

TABLE 2
FREQUENCY OF RECOVERY OF *DANAUS GENUTIA*

Recovered after days of marking	Number
0	1
7	9
14	9
21	3
28	2
35	7
42	1
49	2
56	0
63	1

To determine whether the butterflies left this location at any other time of the day, and if so, when and in which direction, one evening, we reached Tiger Valley at about 1730 hrs, caught a few specimens, and kept them in a bag, to release them in the morning. The next day, we reached the valley at about sunrise and released the butterflies. We stationed ourselves at various places to record the direction of flight, and to see if the roosting butterflies left the site in the morning. The released butterflies flew in a somewhat southerly direction for less than a few hundred metres and remained on the top of the canopy until the sunlight reached the Valley. As the sun reached the canopy, they started fluttering and moving slowly towards the upper end of the canopy where they basked, and after about an hour, when the temperature rose, they slowly started moving down. By about 1030 hrs they all seemed to be settled and resting. One of their major activities was basking. The sunlight reached the Valley in spots and its intensity varied in the canopy. The butterflies generally preferred shade. There was a dense growth of fern in the Valley in the flowing water, and many butterflies were seen sitting on them. The major plants in the area were identified as *Macaranga peltata*, *Ficus* sp. *Adina cordifolia*, *Caryota urens*, *Putranjiva roxburghii*, and *Mangifera indica*.

The high recovery of marked butterflies (4-5%) suggests that this population was quite stable. We did not recover any butterflies in the first three visits since we started marking (Table 1). This could be explained by the low probability of recapture when the numbers were high or that the population was not stable at that time (moving out of the area and being replaced by a fresh group of butterflies). But, as we did not see any movement in the congregation site, the latter

explanation seems unlikely. Also, the recovery seemed to increase later. Although there were butterflies at various heights, up to about 15 m, our captures were mostly from butterflies roosting on the ferns, and easily reachable. The results suggest that the butterflies remained at or near the site where they were captured initially. Thus, it seems likely that this population was an overwintering population, which at the onset of monsoon or a suitable season dispersed to breed. Host plants such as *Ceropegia* sp., *Marsedenia* spp. (I did not record any larvae on these plants) were very few in the Park and could not support the whole population. This suggests that this large population could not have bred in the Park and would have to disperse outside the Park to breed. In Mumbai, although Chaturvedi (1979, 1998) and I have observed migration of other danaids in fairly large numbers, such numbers of *D. genutia* have not been seen. There is a possibility that the butterflies arrived in smaller numbers and assembled here. During October and November we generally observe movements of butterflies from north to south, and northward migration is observed at the onset of monsoon from July onwards (Chaturvedi 1998 and MH pers. obs.). No migratory movements are observed during March to June. So why did the butterflies select this place? Is it a traditional hibernating spot unknown so far? A worker at the filtration plant, when questioned, said that he had not seen large congregations of these butterflies earlier. Amar Mehta and Ulhas Paralkar visited the site again in 1993, but did not find the butterflies. They noticed that the undergrowth had been cleared. It seems that the butterflies chose this site as it was cool and moist even in summer, with a continuous supply of water from the filtration plant to provide ideal conditions for overwintering. I have seen relatively large numbers of danaids, especially *Euploea core* and *E. klugii* in the region but no congregation.

There is no earlier record of overwintering populations in the Park or elsewhere in the country. In fact, no such phenomenon has been recorded for any other danaid in the Eastern Hemisphere. Climatic conditions in the Eastern Hemisphere are very different from those in the Western Hemisphere. The Common Tiger butterflies are found throughout the Indian subcontinent from southern Kashmir eastward to China and south. Thus, it seems possible that the northern population would migrate south to escape the cold and dry weather of north India. If these butterflies are from the population in north India, we may consider them overwintering butterflies during dry months. The butterflies caught in the beginning were already a few days old and had lived for at least four months. Therefore, we suggest that these butterflies dispersed to breed when the conditions improved in monsoon. Unfortunately, we did not conduct any studies to find out the reproductive condition of these butterflies in their overwintering sites, but have evidence that they mated when they were at the site. Further study to answer these questions is impossible, as the site has already been destroyed and it is possible that the butterflies have found another similar site.

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25. ON *HESTIASULA BRUNNERIANA* SAUSSURE (INSECTA: MANTODEA) FROM PUNE, MAHARASHATRA

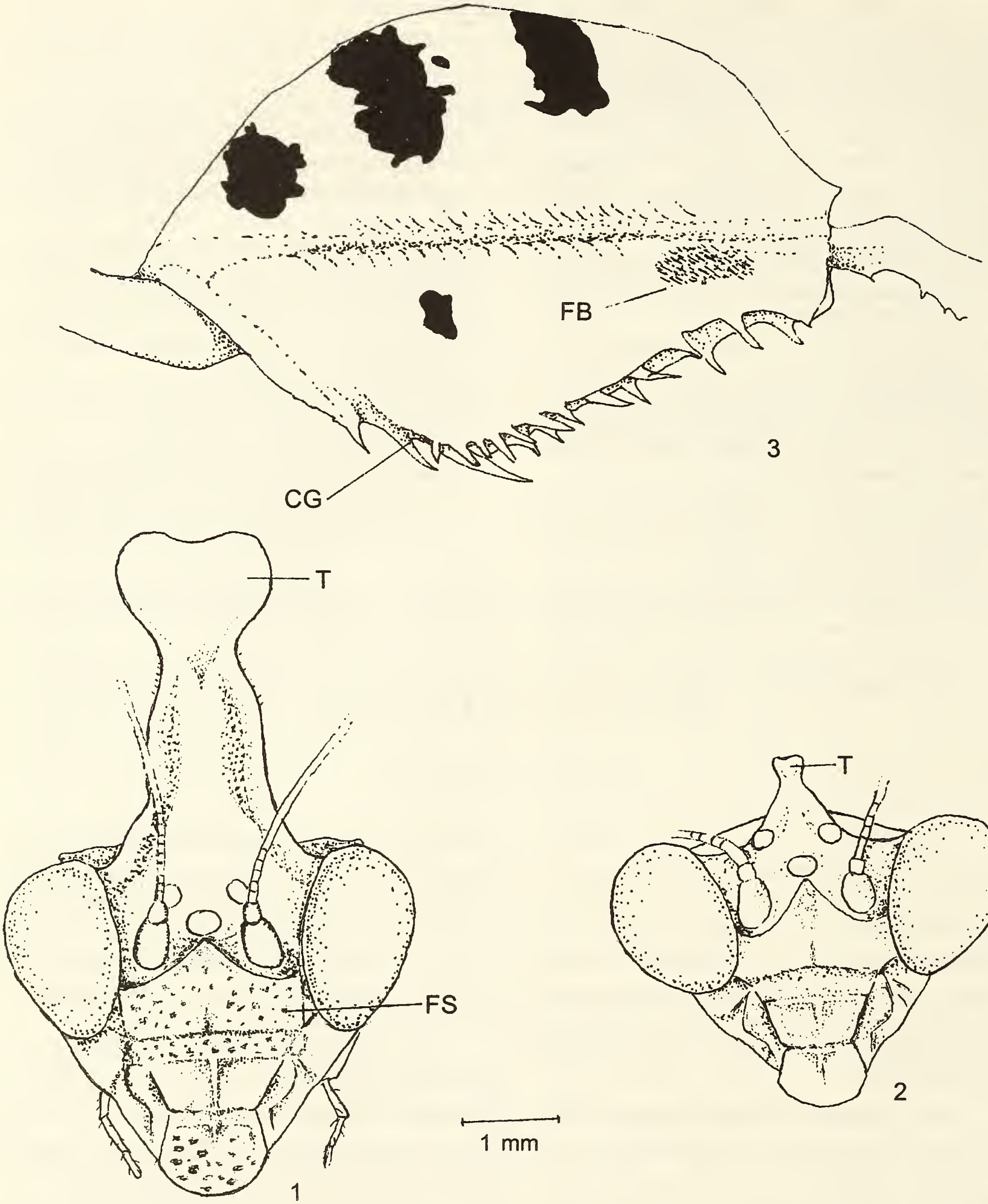
(*With three text-figures*)

On August 19, 1998, we first collected a colourful male specimen of a preying mantis on the campus of Pune University. Additional specimens, two males and three females, were collected in Pune during 1998-2000. All the mantids were collected live and maintained in the laboratory to observe food, feeding and general behaviour. Only four specimens have been preserved.

The important diagnostic characters of this mantis were as follows: External spines of the fore tibiae numerous, closely set (Family Hymenopodidae). Frontal sclerites without wing-like keels, eyes within circumference of head (Subfamily Acromantinae). Middle and hind femora without any significant lobe, disc of frontal sclerite smooth, superior border of fore femora strongly arched and foliaceous (hence the genus *Hestiasula*). The species *H. brunneriana* was confirmed by the characteristic pattern of bold black blotches on the inner face of fore femora (3 blotches on the superior margin and one black spot near the spine in the middle of the fore femur) (Mukherjee *et al.* 1995).

Major taxonomic characters of this species are already given by Mukherjee *et al.* (1995). However, variations that we found in the two female specimens collected at Dapodi (27.iii.2000 and 2.iv.2000 specimens) are:

1) The costal area of the forewing was brownish opaque in two females and brownish-green in one male. Even in the live specimen, the brownish colour was evident in these two females as against the distinct green in others



Figs 1-3: 1. Frontal view of the head of female, note the long bilobed tubercle (T) on the vertex;
2. Frontal view of the head of male. Note the comparatively small tubercle (T);
3. Inner face of femur, note the specific pattern of 3 black blotches and a spot
FB: Femoral brush, CG: Claw groove, T: Tubercle, FS: Frontal sclerite

TABLE 1
MORPHOMETERY (IN MM) OF *HESTIASULA BRUNNERIANA*

No.	Total Length	Fore Wing	Hind Wing	Head Length	Head Breadth	Prozona	Metazona	Fore coxa	Fore femur	Fore tibia	Sex
1	21	20.5	19	2	4.2	1.7	1.7	5.6	6.5	3.3	Male
2	25	24	21	2.3	4.4	2	2	6	7.5	4	Female
3	23	21	18	1.9	4	1.7	1.7	5	6	3	Male
4	22	21	18	1.7	4	1.7	1.7	4.8	6	3	Male
5	27	23.5	20	2	4.2	1.9	1.9	6	7	3.5	Female
6	23.5	22	19	2.2	4.2	2	2	6	7	4	Female

(costal area said to be greenish opaque for the species). 2) Mid and hind legs are not annulated brown, but are translucent with prominent black annulations. 3) The inner face of the fore femur normally has three black patches on superior edge and one black spot just above the spines in the middle of the femur. In one female (specimen no. 5), the right fore femur has the usual pattern, while on the left fore femur there is only a single patch on the superior edge (this is certainly an aberration). The usual spot above the spines, in the middle of the femur, is present.

Except for the black patches, the inner face of the fore femur is crimson in all the specimens we have observed — a feature not reported for the species. There are also small white patches encircled by black, just behind the mid and hind-coxa. These patches are near the thoracic spiracles.

The male and female can be easily differentiated by the prominent bilobed tubercle on the vertex in the female; this tubercle is 3 times longer than the simple tubercle of the male. This is an important sexual dimorphic character, apart from the anal styles, which are present in the male only (Figs 1 & 2).

These small mantids are active fliers. The opaque green colour of the costal area of the forewing is very prominent. The brownish coloration may be a seasonal variation, which we have noted in many other mantid species. The wings of the live mantid are shining. The crimson inner face of the fore femur, with its pattern of black patches (Fig.3), is highly prominent when the insect moves one of those foliaceous fore femurs and it is distinctly different from the brownish colour of the outer face of the fore femur.

In captivity, these mantids readily accepted small moths attracted to the light at night. Presumably this is why these mantids are attracted to the fluorescent light. Even houseflies and small cockroaches (*Supella* sp.), provided in captivity, were readily eaten.

Hestiasula brunneriana is hitherto known only from Andhra Pradesh, Meghalaya, and West Bengal in India. Elsewhere, it is known from Bangladesh and Sri Lanka. Neither Nadkerny (1965), Mukherjee and Hazra (1983), nor Mukherjee *et al.* (1995), have recorded this species from Maharashtra. Thus, its occurrence in Pune, Maharashtra, is a range extension of this species to western India, as the previous records are confined to the eastern parts of India.

The female *H. brunneriana* (specimen no. 6) deposited an ootheca, containing fertilized eggs, on April 5, 2000. It was 9 mm long, 5.5 mm broad, and 4.8 mm high. The ootheca carried a 7 mm long, thin thread-like process. The nymphs hatched out in 26 days on May 1, 2000. This species, therefore, seems to breed in summer.

Material examined: Male, 19.viii.1998, University Campus, Pune, coll. Rahul Marathe; Female, 23.iii.1999, Kothrud, Pune, coll. Anand Padhye; Male, 3.iii.2000, Dapodi, Pune, coll. Rajpreet Kaur; Male, 3.iii.2000, Dapodi, Pune, coll. Rajpreet Kaur; Female, 27.iii.2000, Dapodi,

Pune, coll. Rajpreet Kaur; Female, 2.iv.2000, Dapodi, Pune, coll. Rajpreet Kaur.

All the mantids were collected when attracted towards fluorescent light.

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26. REDESCRIPTION OF *AMORPHOSCELIS ANNULICORNIS* STAL (INSECTA: MANTODEA) FROM MAHARASHTRA

(*With two plates*)

Recently, two specimens of a very interesting mantis were collected at Pune, and subsequently two in Tadoba (Chandrapur), Maharashtra State. The mantis was easily placed in the Family Amorphoscelidae because of a set of characteristics as follows: i. short, squarish, tuberculate pronotum (Plate 1, Fig 1). ii. femur and tibia without spines (except a single discoidal spine on femur, Plate 1, Fig. 2) and iii. anal cerci racket-shaped due to expanded distal segment.

In India, there is only one genus under this family, namely, *Amorphoscelis* of which there are only 3 known species (Mukherjee *et al.* 1995). The species *A. annulicornis* Stal was diagnosed by the presence of tubercles on anterior and posterior borders of the pronotum, and the colour pattern of the body. This mantis is supposed to be a common bark dwelling species, occurring in almost all the warmer parts of India. Although there is a report of the genus *Amorphoscelis* from Andheri, Bombay (Nadkerny 1965), there is no previous record of *A. annulicornis* from Maharashtra (Mukherjee *et al.* 1995), hence this report.

A brief description of the species is given by Mukherjee *et al.* (1995). Some additional taxonomic features and photographs of this mantis are given here, which will help to identify it. Except for one specimen which is dark brown, all the specimens are brown with brownish-black marks on the forewings.

Redescription: Head triangular, dark brown with black dots on vertex. Vertex tuberculate with distinct lobulations; lateral lobes cone-shaped, apex of the cone facing posterior side. Frontal sclerite transverse; eyes dorsoventrally flattened, black; antennae thin and longer than body, each segment basally yellowish and apically black; antennal segments increase in length gradually from base to apex and possess a few setae.

Ghate, H.V. *et al.*: *Amorphoscelis annulicornis* PLATE 1

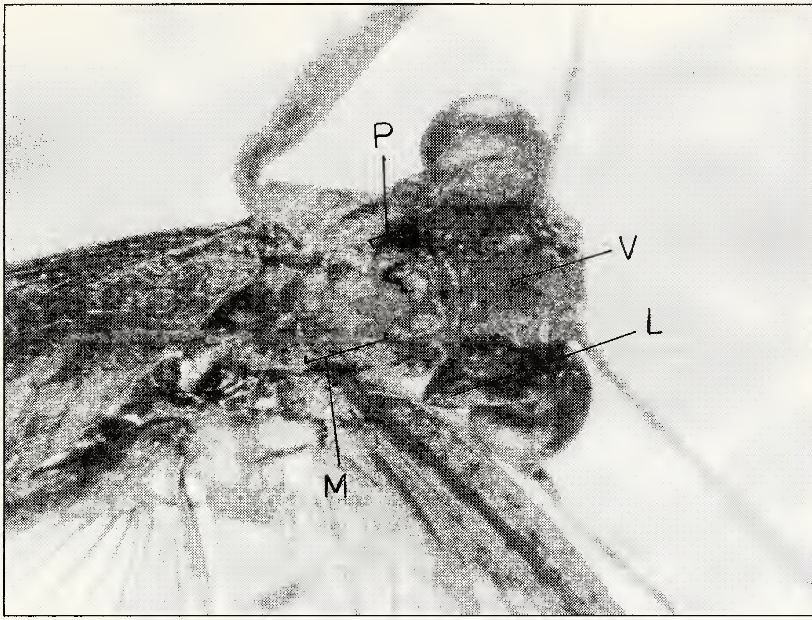

Fig. 1: Head and prothorax

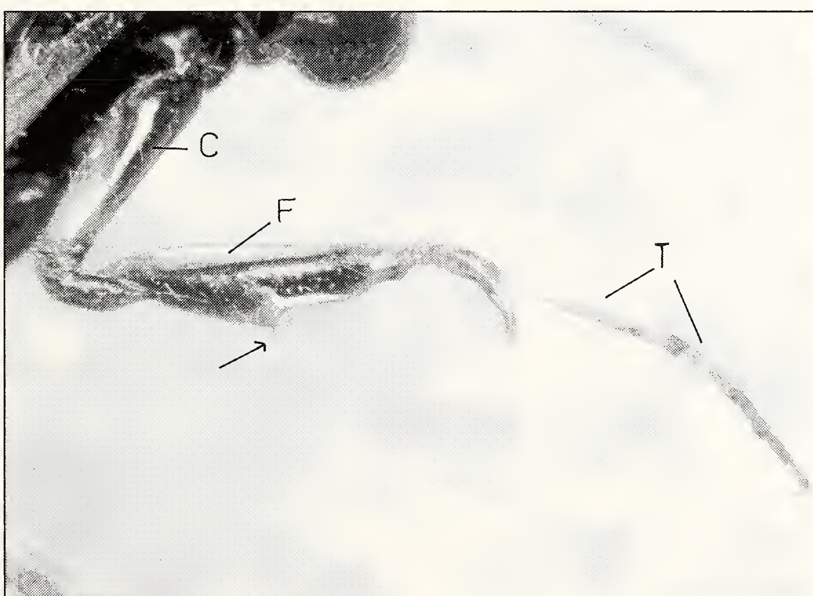

Fig. 2: Foreleg

C: Coxa, F: Femur with single discoidal spine, L: Lateral lobe of vertex, M: Metazona, P: Prozona, T: Tarsal segments, V: Vertex

Ghate, H.V. *et al.*: *Amorphoscelis annulicornis* PLATE 2

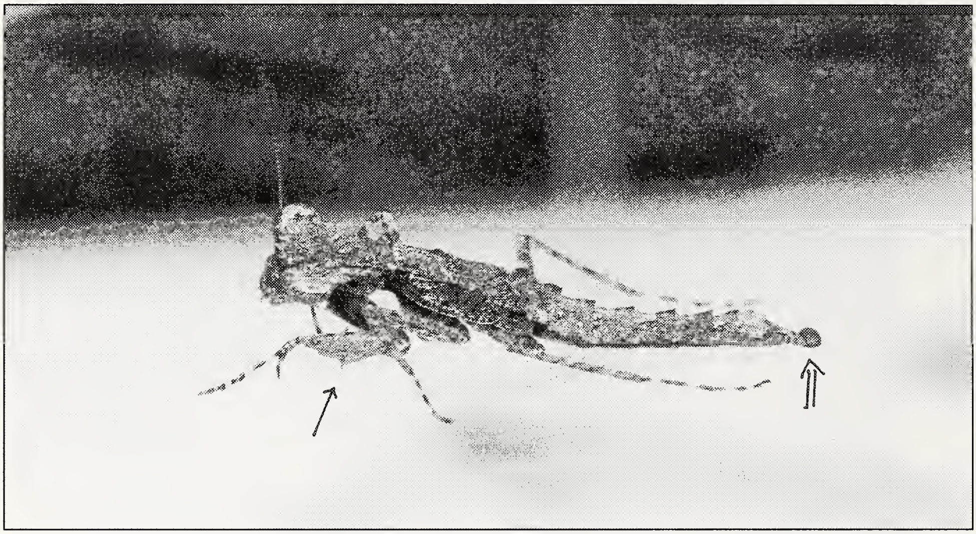

Fig. 3: Lateral view of the nymph, note the characteristic single forefemoral spine (arrow) and racket shaped cerci at the tip of abdomen (double arrow)

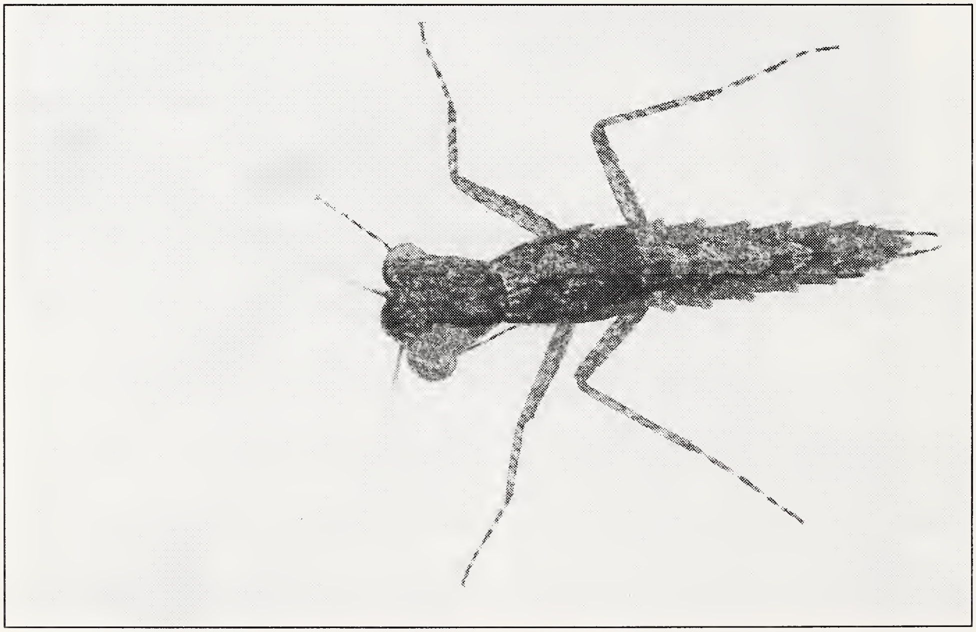

Fig. 4: Dorsal view of nymph, note the peculiar arrangement of abdominal segments and dorsal colour pattern. Also note the annulations on legs and wing buds

TABLE 1
MORPHOMETRY OF *AMORPHOSCELIS ANNULICORNIS*

Sr. No	Total length	Fore wing	Hind wing	Head length	Head breadth	Pronotal length	Coxa	Femur	Tibia	Antenna
1	16.5	14	12	1.7	4.5	1.9	2.5	3	0.6	-
2	16.5	14	13.5	1.4	3.9	1.6	2.5	3	0.6	19
3	17	16.5	15	1.7	3.9	1.7	2.4	3	0.5	22
4	17.5	15.5	14.8	1.8	3.8	1.5	2.4	2.8	0.6	-

All measurements are in millimetres

Pronotum tuberculate; prozona and metazona not clearly demarcated, though with a thin carina on the metazona. Forewings opaque brown with darker spots and patches; hindwings with costal area opaque brown, rest of wing shining transparent, with brownish tinge.

Forelegs short; coxae yellowish-brown, internally basally black; forefemur with characteristic single discoidal spine; conspicuous setae present along the ventral edges of femur; median internal area of the femur (except borders) black; base of the femur also black, which is a variation from the character described by Mukherjee *et al.* (1995); tibiae and tarsal segments setaceous; tibiae yellowish with three black bands or rings, or sometimes (2 specimens) with small black spots without forming rings (again a variation, the earlier description indicates black tibiae with yellow bands). Metatarsus with three black rings or bands; each tarsal segment with basal and apical black band. In case of mid and hindlegs, coxae shining black (variation, as the bases of the coxae have been described as pale); trochanter and femur yellowish-brown, setaceous. Femora and tibiae of mid and hindlegs triannulated because of dark coloured rings.

Abdominal segments dorsally brownish, ventrally shining black and hairy; cerci hairy and racket-shaped due to the enlarged distal segment; total length of cercus in one specimen 2.25 mm, the enlarged last segment 0.85 mm long.

All four examples male, attracted towards fluorescent tubelight, from which they were collected. The locality and other data are as follows:

1. 24.iv.1999, near Vanaz factory (Paud road, Pune), coll. Abhay Soman; 2. 15.ix.1999, Dapodi, Pune, coll. Rajpreet Kaur; 3. 7.xii.1999, Tadoba, Chandrapur, coll. Rahul Marathe; 4. 9.i.2000, Tadoba, Chandrapur, coll. Rahul Marathe.

In addition to adults, we have recently collected one final instar nymph (total length 15 mm) of *A. annulicornis* in Pune, 30.iii.2000, very close to Modern College, coll. J.K. Kadav.

Morphometry: Measurements of important body parts of all four specimens are given in Table 1.

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27. NEW RECORDS OF HOLOTHURIANS (ECHINODERMATA: HOLOTHURIA) FROM ANDAMAN AND NICOBAR ISLANDS

(*With two text-figures*)

The Andaman and Nicobar Islands spread out in the Bay of Bengal between 6° 45'-13° 45' N and 92° 15'-94° 15' E, have one of the richest coral reef formations with fringing reefs on the eastern side and barrier reefs on the western side. The present communication deals with new records of holothurians from these islands. The coral reefs of Andaman and Nicobar Islands offer ideal habitats for littoral sea cucumbers and other echinoderms. There have been several reports (Theel 1882, Koehler and Vaney 1908, James 1969, 1983 and Shastry 1998) on the echinoderms from these islands.

During a coral reef survey of the Mahatma Gandhi Marine National Park, Wandoor (South Andaman), by night and day SCUBA diving, interesting species were collected. The holothurians were preserved in 10% formalin, identified with the aid of keys formulated by James (1969) and Kulkarni (1996). For examining spicules, tissues from different parts of the body were cut and dissolved in a concentrated solution of potassium hydroxide. The spicules were then observed under a microscope and drawn to scale.

Two species of holothurians are recorded for the first time from the Islands. The characteristics of these species are given below.

FAMILY: Stichopodidae Hackel, 1896
GENUS: *Thelenota* Clark 1921
Thelenota ananas (Jaeger, 1833)

Material: Twins Is., 12 m, Rutland Is. 7 m, Boat Is. 9 m depth.

Description: Tentacles 20, length 300 to 425 mm and width ranging from 100 mm to 150 mm. Dorsal and ventral sides well differentiated. Ventral pedicles arranged irregularly. Shape of body sub-rectangular and elongated, characterized with numerous pointed papillae, which are large, conically compressed with their bases united, giving a semistar-like appearance all over the body. Mouth surrounded by 18 to 24 tentacles, papillae. Dorsal papillae double and united at the base to give a star-like appearance. Ventral pedicles arranged irregularly. Live specimens light maroon in colour with an interstitial black zone between the papillae. Spicules (Fig. 1) consist of simple and dichotomously branched rods. Some rods smooth and curved.

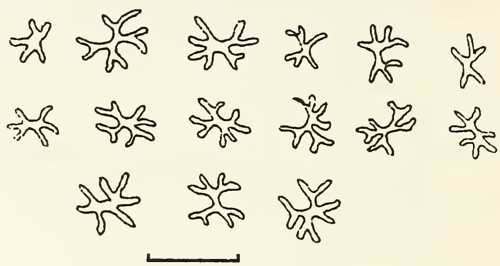

Fig. 1: Spicules of *Thelenota ananas*

Habitat: Sandy bottom and coral rubble.

FAMILY: Synaptidae Burmeister, 1837
GENUS: *Euapta* Ostergren, 1898
Euapta godeffroyi Semper, 1898

Material: Grub Is. 6 m, Jolly Bouys Is. 14 m depth.

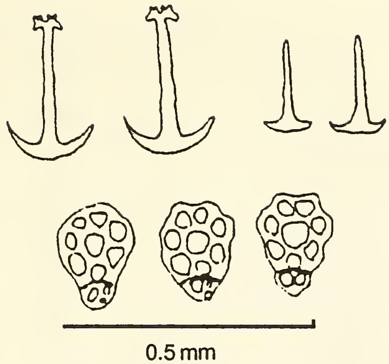

Fig. 2: Spicules of *Euapta godeffroyi*

Description: Length of live specimen 1.75 m, 40 cm when contracted. Body is soft, sticky flexible and highly extensible. 18 pinnule tentacles with digits united by a web in each tentacle. Body surface covered with several rows of closely packed white papillae, giving it a striped appearance. Gonads consist of a number of tubules.

Pale brown in colour with large dark brown bands, equally spaced across the dorsal side. Ventral side pale brown. Spicules present as anchors and anchor plates. Anchor plates narrow at posterior end, more or less circular with about 7 large holes and 3 small holes at the handle side. There is an identical bridge near the handle for the attachment of the anchor. Anchors small, on the vertex of the anchor are two dents. Flukes of the anchor smooth and of equal size (Fig. 2).

Habitat: Sea grass beds, coral boulders.

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28. NEW RECORD OF *MACROBRACHIUM DAYANUM* HENDERSON, 1893 FROM A FRESHWATER ECOSYSTEM OF TRIPURA, INDIA

(*With one plate*)

Studies on prawns are important from an aquaculture view point (Thakur *et al.* 1994, ASFA 1998). Knowledge of their ecological niche conditions is also needed to clearly record

the nature of their distribution, (FAO 1985, Qureshi 1994, ASFA 1998).

A description of *Macrobrachium dayanum* Henderson 1893, with its niche characteristics, i.e. physico-chemical factors of water, occurrence of several phyto- and zooplanktonic food biota, preference for macrophyte substrata and seasonal abundance of *M. dayanum* are given.

This work was carried out in a freshwater wetland ecosystem in Agartala (23° 50' 15" N, 90° 15' 45" E), Tripura, from March 1996 to February 1998. The mean depth of the study site varied from 0.63 ±30 cm during winter to 130 ±33 cm in monsoon. The littoral zone supports a number of macrovegetation species. Fish are cultured in this wetland by stocking with fry and fingerlings of Indian major carps for a seasonal period.

This study is based on live specimens of *M. dayanum* collected weekly from the roots of the hydrophytes in the littoral zone.

Samples of plankton and water were collected from the periphery of the prawn sampling zones. Physico-chemical parameters of water, i.e. temperature, transparency, pH, free carbon dioxide, dissolved oxygen, bicarbonate, dissolved organic matter, chlorinity, salinity, silicate, phosphates and nitrates were analysed adopting the methodology of APHA (1995). The physico-chemical parameters data were pooled into a mean value (Table 1) describing the limnological feature of the studied wetland. The works of Ling (1969), Kurian and Sebastian (1986) and Jalihal *et al.* (1988) were consulted for taxonomic identification of the prawns.

Rostrum curved upwards, rostral formula 9/6 (dorsal / ventral) in most cases and 8-9 / 5-6 in a few individuals; arrangement of dorsally placed rostral teeth not uniform; 5th walking legs of the same length as the fourth; 2nd chelae of adult male equal or subequal; fingers of the 2nd chelae grooved longitudinally with velvety hairs in the groove; walking legs covered with velvety hairs; walking legs as well as dorsal body

TABLE 1
PHYSICO-CHEMICAL CHARACTERISTICS OF THE FRESHWATER WETLAND

Physico-chemical factors	Range	Mean	±S.D.
Water temperature (°C)	15-30	24.5	5.12
Transparency (cm)	13-19	16.33	2.42
pH	7.4-7.6	7.46	0.07
Bicarbonate (ppm)	106-127	118.33	7.52
Dissolved oxygen (ppm)	5-7	6.16	0.68
Silicate (ppm)	4-8	5.83	1.34
Chlorinity (ppm)	10-30	20.00	8.16
Salinity (ppt)	0.01-0.03	0.02	0.01
Phosphates (ppm)	0.3-0.4	0.35	0.05
Nitrates (ppm)	0.3-0.4	0.33	0.04

surface with brown stripes; eggs brownish, small (<0.70 mm) (Plate 1, Fig. 1)

Body length (male)	=	4.9-7.8 cm
Body length (female)	=	4.5-6.4 cm
Body width (proximal)	=	0.7-1.2 cm
Body width (distal)	=	0.2-0.4 cm
Length of 2nd walking leg	=	2.3-4.0 cm

Phytoplankton: The dominant phytoplanktonic species were *Chlorella vulgaris*, *Cymbella*, *Ceratium hirundinella*, *Nietzschia commutata*, *Euglena acus*, *Phacus pleuronectes* etc. Of these, *Chlorella vulgaris* was the most dominant. The peak abundance of the algae was in winter.

Zooplankton: Rotifers (*Brachionus*, *Keratella*, *Lecane*, *Euchlanis*), Cladocerans (*Ceriodaphnia*, *Bosmina*) and Copepods (*Cyclops*, *Eucyclops*) were recorded. Of these, rotifers were dominant both qualitatively as well as quantitatively. Among all genera, *Brachionus* was the most dominant. The peak abundance of rotifers was in winter.

Preference for plant substrata: Although *M. dayanum* was observed all along the periphery of *Ipomea aquatica* and *Eichhornia crassipes*, maximum density (65 individuals per litre of water) was recorded from the roots of the latter.

Seasonal abundance of prawn: During the two-year study period, *M. dayanum* exhibited highest density in winter and lowest in summer.

Banik, S. *et al.*: *Macrobrachium dayanum* PLATE 1

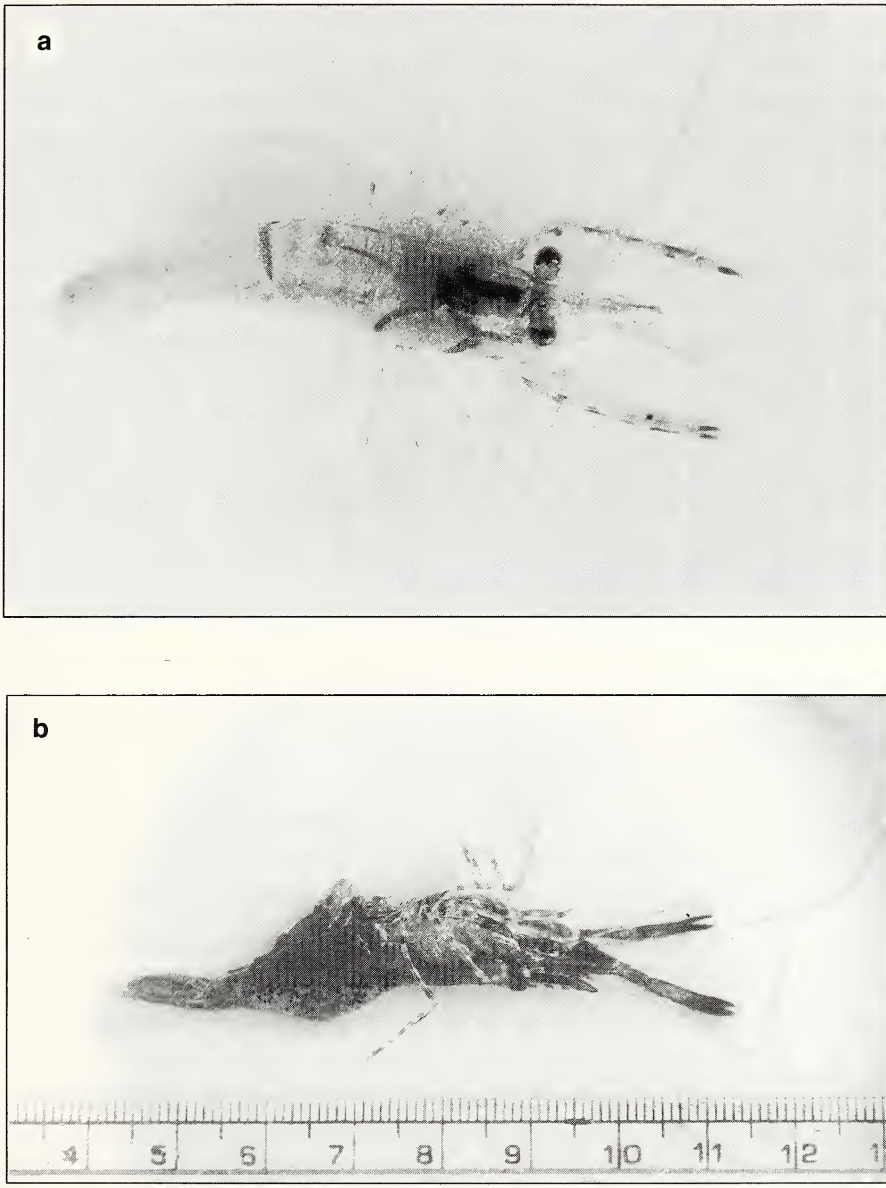

Fig. 1: *Macrobrachium dayanum* a. Male, b. Female

The prawn species occurred under certain limnological conditions which shows that it is highly specific in regard to seasonal abundance and species specific in regard to substrata selection (Banik 1996). Though recorded in a freshwater lentic ecosystem in the present study, *M. dayanum* Henderson, 1893, is basically of marine origin and probably entered freshwater habitat by migrating via a riverine system (Tiwari 1955, Kurian and Sebastian 1986). Though it was known earlier from some states of India (Tripathi 1992, De 1996), it is reported here from Tripura and also from northeast India (ASFA 1998) for the first time. This report also confirms its cosmopolitan distribution (FAO 1985, Thakur *et al.* 1994, ASFA 1998).

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29. THE GASTROPOD *STENOTHYRA ORNATA* ANNANDALE AND PRASHAD 1921, A NEW RECORD FROM RIVER GANGA IN BIHAR

(*With one text-figure*)

The gastropod *Stenothyra ornata* Annandale and Prashad 1921, originally known from a brackish-water pool near Calcutta, has been recorded for the first time from the

freshwater zone of River Ganga at Sultanganj (771 km from the sea) in Bihar. The species is characterized by spines on the whorls, which are keeled in the middle.

Family Stenothyridae (Mollusca: Gastropoda) is distributed from Iran to Indonesia, from Australia to the Philippines and Japan, and Western Pacific Islands (Rao 1989). Neubert (1998) first recorded the genus *Stenothyra* from the Arabian Peninsula. *Stenothyra arabica* has been collected from several localities in Saudi Arabia, Yemen and Oman. Two genera, namely *Stenothyra* Benson 1856 and *Gangetica* Ancey 1890 are included in this family (Neubert 1998).

In May, 1998 two live specimens of *Stenothyra ornata* Benson were collected from submerged vegetation in the littoral zone of River Ganga at Sultanganj, 25° 15' N and 86° 44' E, (771 km from sea) near Bhagalpur, Bihar, while assessing the habitat preference of the Ganges river dolphin vis-à-vis biological diversity of River Ganga.

Diagnosis: The shell is conoidal ovate and brownish. Apex acutely pointed, with 5 whorls. Shell imperforate. Spiral whorls distinctly keeled in the middle, keel continues on to body whorl. Spiral rows of blunt, flattened horny and blackish spines on last two whorls in the region of the keel; spines directed towards apex.

Measurement of one of the shells by ocular micrometer (except length of the shell and breadth of the body whorl) is as follows:

Length of shell .... 4.5 mm
Breadth of body whorl .... 3.0 mm
Length of 1st whorl .... 50 μ
Length of 2nd whorl .... 200 μ
Length of 3rd whorl .... 275 μ
Length of 4th whorl .... 525 μ
Length of 5th whorl .... 1975 μ
Size of aperture .... 1150 x 1300 μ
Height of a spine .... 125 μ

The first two whorls are minute, the third onwards are broad and somewhat band-shaped. Viewed from the dorsal side, the body-whorl is sub-quadrate, ventrally it appears somewhat ovoidal, with the inverted apex sharply truncated. The mouth of the shell is minute, oblique and regularly subcircular. The rim of the mouth does not project at all and the shell is not umbilicate (Fig. 1).

Affinities: Annandale and Prashad (1921) remarked that the species *Stenothyra ornata* is closely allied to *Stenothyra deltae* (Benson) and *S. echinata*, but is distinguished by the larger and more acute spire, form of the body whorl, keeled nature of the whorls, sculpture and by the comparatively shorter and more circular mouth.

Annandale and Prashad (1921) revised the genus and recognized twelve species. They stated that these small water-snails, the shell of which is rarely more than 5 mm long, are found mainly in brackish water. A few make their way far inland, but it is doubtful whether any species exists only in fresh water. However, *Stenothyra foveolata* Benson was the only species known from the River Ganga at Sakrigali (5 km downstream of Sahibganj, Bihar), a distance of 650 km from the sea and about 466 km above the extreme tidal influence, but it may occur lower down as well as in the Gangetic delta (Annandale and Prashad 1921). Rao (1989) reported that the Family Stenothyridae is mainly estuarine and so far none of the species except *Stenothyra deltae* are reported from freshwater in India. However, distribution of *S. deltae* has been recorded up to Chandpal Ghat, Calcutta, in the tidal zone (Rao 1989). Annandale and Prashad (1921), however, reported that they were not aware of the location of the types, *S. deltae*, but the specimens in the Indian Museum are represented from Port Canning, Calcutta (Chandpal Ghat), Patna and Bhagalpur.

The species of *Stenothyra* frequent submerged vegetation or stones covered with

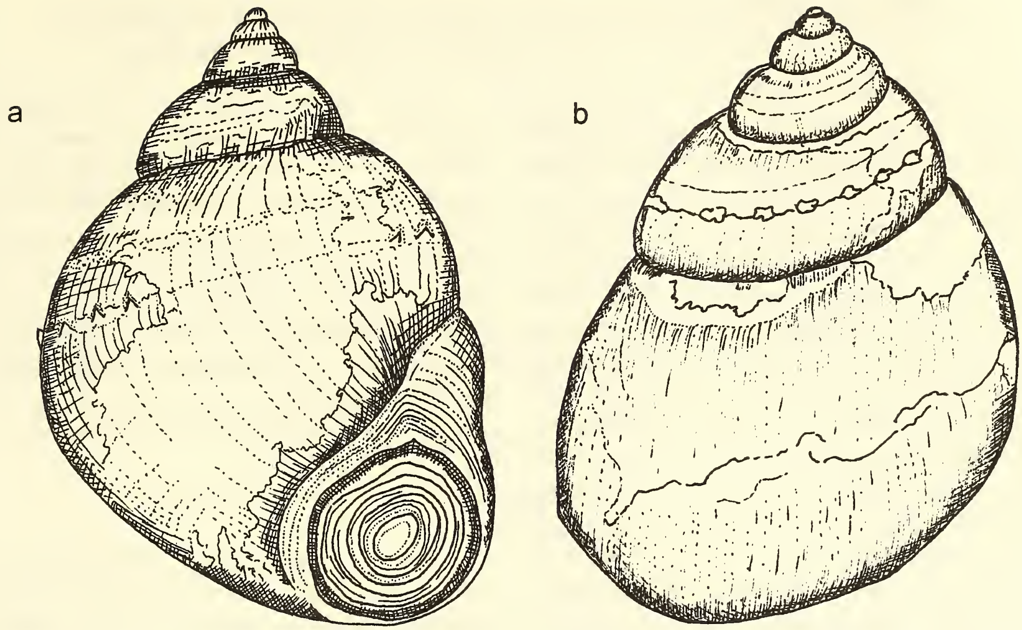

Fig. 1: *Stenothyra ornata* Annandale and Prasad, 1921, a. Ventral view, b. Dorsal view

algae and scrape them for t he minute organisms that form their food. Their mobile and extensible snouts enable them to feed easily on the algae that grow on the shells of their companions and even from their own shells.

Stenothyra ornata may be one of the marine elements of the Ganga. However, it is not certain if the species has existed from the origin of the river or has entered the freshwater zone from the estuarine zone along with ships. Nevertheless, it has completely adapted itself to the freshwater zone of the river. Unless collected and sorted carefully, it is difficult to isolate the animal from the submerged vegetation due to its minute size. It can be confused with juveniles of other gastropods.

ACKNOWLEDGEMENTS

We thank Dr. Fred Naggs of British Natural History Museum, London for his help in identifying the specimen. The financial assistance to research biodiversity of the Ganga by the Biodiversity Support Programme, a USAID funded Consortium of World Wildlife Fund, the Nature Conservancy, and World Resources Institute is duly acknowledged.

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30. NEW RECORDS OF THE CLAM *CYRENA CEYLONICA* (CHEMNITZ), MOLLUSCA: FAMILY CYRENIDAE, IN ANDAMAN ISLANDS

The literature available on the molluscan resources of the Andaman and Nicobar Islands is scant except for the few reports of Melvil and Abercrombie (1893), Setna (1933) and Rao (1939). The present study reports the occurrence of *Cyrena ceylonica* (Chemintz) in Andaman Islands. In Sri Lanka, it was recorded by Preston (1915). This black-shelled clam, locally called *chippi*, is abundant in mangrove creeks and inlets, usually buried in the muddy substratum. It is collected live along the coastal habitats during low tide by handpicking by the tribals and local villagers, for whom it is a cheap source of animal protein. The shells are used in several lime-based industries in these islands. The clams are also uti-lised as broodstock diets for prawns and fishes in hatcheries and in aquaria due to their easy availability, palatability and hardiness in confinement.

On an average 100 specimens from each location in the South, Middle and North Andaman were collected and identified from Preston (1915) and also by consulting molluscan specialists of Vizhinjam Research Centre of Central Marine Fisheries Research Institute. Samples are kept in the museum of the Fisheries Science Division, CARI, Port Blair.

Out of seven species of *Cyrena*, namely *Cyrena ceylonica*, *C. impressa*, *C. sinuosa*, *C. bengalensis*, *C. tennentii*, *C. proxima* and *C. galatheae* occurring in different parts of the world, only *C. galatheae* has been reported earlier in Nicobar Islands (Preston 1915). The distribution range of *Cyrena ceylonica* has been stated as tropical and subtropical regions of Asia, Africa, America, Australia and Oceania. This is the first record of the occurrence of *Cyrena ceylonica* in Andaman and Nicobar Islands.

Acknowledgements

We thank the Director, CARI for facilities, and Dr. Kumara Swami Acharya, Senior Scientist, Vizhinjam Research Centre, CMFRI, Trivandrum, Kerala for help in identification. We also thank the staff who extended co-operation and assistance in the field.

August 26, 2000

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31. *ALYSICARPUS OVALIFOLIUS* (SCHUMACH.) J. LEON (LEGUMINOSAE: PAPILIONOIDEAE) — A NEW RECORD FOR THE EASTERN GHATS

(*With one text-figure*)

While working on the Leguminosae of Eastern Ghats, peninsular India, we collected an interesting plant from Nallamalai hills, Andhra Pradesh. On comparison with the

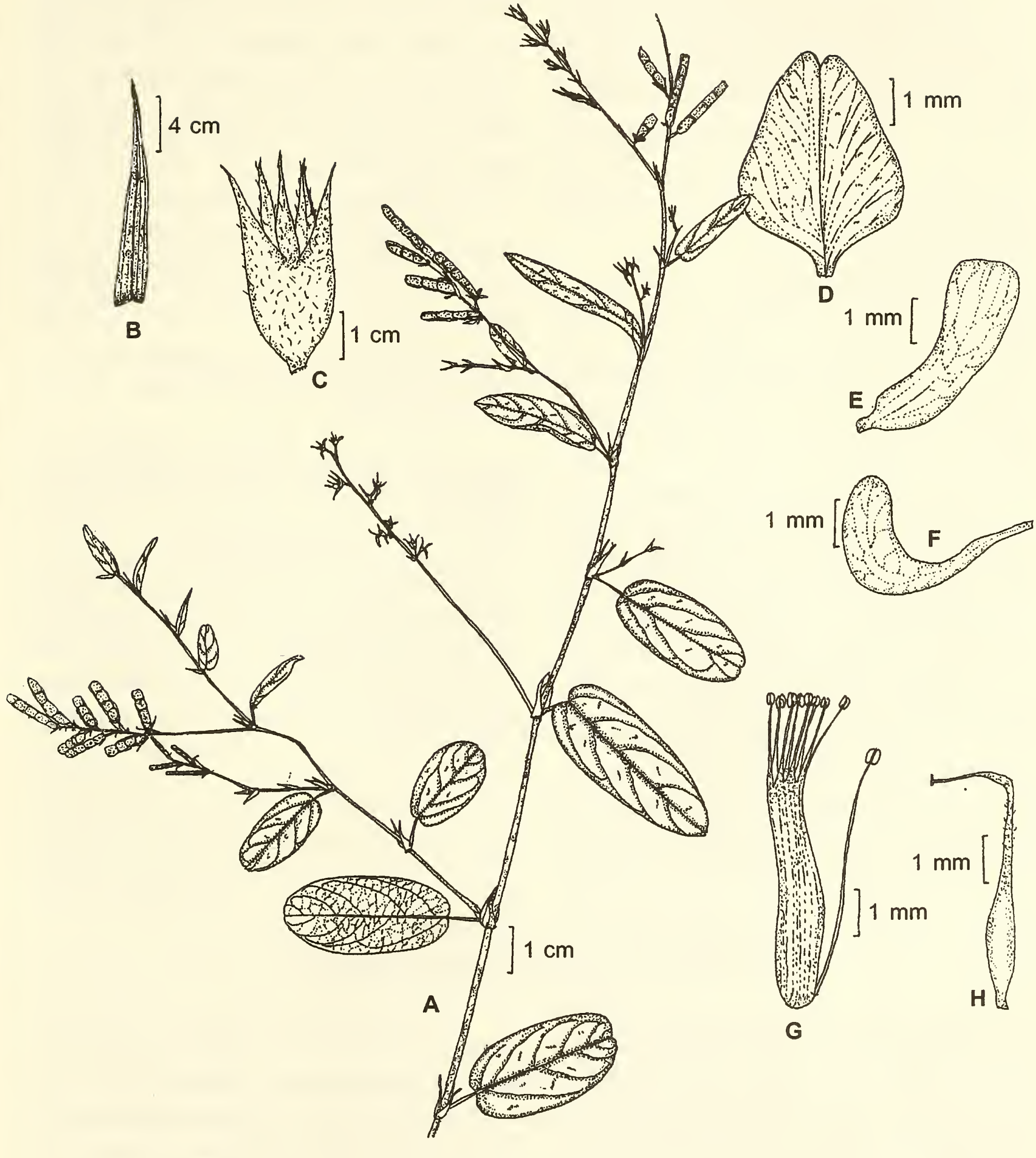

Fig. 1: *Alysicarpus ovalifolius* (Schumach.) A. Twig; B. Bracteole; C. Calyx; D. Standard petal; E. Wing petal; F. Keel Petal; G. Staminal column; H. Pistil.

literature, it was identified as *Alysicarpus ovalifolius* (Schumach.) J. Leon. which has not been reported from the Eastern Ghats. Hence, the present collection of *Alysicarpus ovalifolius* (Schumach.) J. Leon is a new record for Eastern Ghats. The specimen has been deposited in the herbarium of the Department of Botany, Sri Krishnadevaraya University (SKU), Anantapur, Andhra Pradesh. A detailed description and an illustration are given to facilitate identification.

Alysicarpus ovalifolius (Schumach.) J. Leon. *In*: Bull. Jard. Bot. Etat. Brux. 24: 88. 1964; Sanj. & Bhatt. *In*: J. Bombay nat. Hist. Soc. 75: 254. 1978. *Hedysarum ovalifolium* Schumach. Beskr. Guin. Pl. 359. *Desmodium ovalifolium* (Schumach.) Walp., Rep. 1: 737, 1842.

Annual erect or prostrate herb, up to 50 cm height, branchlets glabrous, striate, branches rooting at nodes with longer internodes. Stipules lanceolate, 0.6-1.3 cm long, striate, acuminate. Petiole 0.5-1 cm long, furrowed on the upper side. Leaves unifoliate, apex acute and mucronulate, base sub-cordate, margin entire, puberulous on the nerves beneath. Inflorescence terminal or leaf opposed, in lax racemes usually with 6-7 pairs of flowers, peduncle 2-3 cm long, pedicel 1 mm long, bracts 4-5 x 1-2 mm, ovate to lanceolate. Calyx tube 8-12 mm long, puberulous, teeth 3-4.5 mm long. Standard pink, 4-5 x 3-4 mm long, wings purplish, keels pale pink. Stamens diadelphous (9+1), staminal sheath 4 mm long, filaments 3 mm long. Ovary pubescent, 5 x 1 mm, style 3 mm long, bearded with long hairs. Pod 1-2.5 x 0.2-0.3 cm, joints 5-7, flattened, 2-3 mm long, puberulous; seeds brown, ellipsoid, compressed with reddish bald patches.

Flowering: August-September.

Fruiting: September-December.

Specimens examined: Upper Ahobilam TP & KSM 14206, Bogada RF Nallamalais KSM 17629.

Distribution: INDIA: Andhra Pradesh, Gujarat, Madhya Pradesh, Maharashtra, Punjab, Tamil Nadu, Uttar Pradesh.

EXTRALIMITAL: Pakistan, Afghanistan, Madagascar, Sumatra, Tropical Africa, China, Indonesia.

ACKNOWLEDGEMENTS

We thank Dr. D.S. Pokle of Aurangabad for identification. The first author (KSM) is grateful to the DOEF and CSIR, New Delhi, for providing junior and senior research fellowships.

June 5, 2000

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32. ON THE TYPE OF *BAUHINIA WRAYI* PRAIN (LEGUMINOSAE: CAESALPINIOIDEAE)

Larsen and Larsen (in Fl. Males. 12(2): 529. 1996) cited *King's Coll.* 5243 (K) as the holotype of *Bauhinia wrayi* Prain, but this is contrary to Art. 9.1 of ICBN (Tokyo Code, 1994), because a number of collections (Perak: *Kunstler* 2238, 2466, 4049, 5243; *Scortechini* 1652; *Wray* 1934, 2782. *Selangor*: *Kunstler* 8758) were cited (with the sign of examination) in the protologue of *B. wrayi* Prain (in *J. Asiat. Soc. Bengal* 66(2): 191. 1897), and these should be treated as syntypes (see Art. 9.4 of ICBN, Tokyo Code, 1994). Thus, the selection of *Kunstler* 5243 (K) as the lectotype of *B. wrayi* Prain by de Wit (in Reinwardtia 3(4): 518. 1956) is in accordance with the rule (see Art. 9.9 of ICBN, Tokyo Code, 1994). In this connection, I would like to point out that the Larsens had accepted de Wit's lectotype earlier. This can be evidenced by their

own annotation (in 1983) on a determination slip affixed to *King's Coll.* 5243 in CAL, on which they annotated 'Iso-lectotype! (de Wit, Reinwardtia 3: 518, 1956)'.

Furthermore, *Kunstler* was one of the collectors of *King* (see Stafleu and Cowan, Tax. Lit. 2: 545. 1979, 2nd ed.), and on the 12 relevant sheets (type herbarium – CAL), with the field numbers 2238, 2466, 4049, 5243 & 8758, printed herbarium labels with the inscription '*Coll. H. Kunstler*' or '*Dr. King's Collector*' (also in print) had been randomly attached. So, it seems that the sheets in K may also have the same type of labelling as in CAL. Under these circumstances, it is quite probable that the specimen cited by Larsen and Larsen as the holotype (*King's Coll.* 5243 - K) is not the same lectotype specimen (*Kunstler* 5243 - K) selected by de Wit, unless one of them had changed *Kunstler* into *King's Coll.* or *vice versa* intentionally.

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33. ON HELFER'S COLLECTION OF *PIPER RIBESIOIDES* WALL, FROM THE BAY ISLANDS, INDIA

The history of botanic explorations of the Andaman Islands dates back to 1791, when Colonel Kyd of the East India Company gardens at Calcutta visited these islands to procure timber trees. Subsequently, Dr Helfer, a Russian geologist who visited these islands to explore their mineral wealth in 1834, made extensive collections of plant material. Unfortunately, he was killed by the aborigines of North Andamans, and most of the specimens he had collected earlier from Tenassarim (Myanmar) got mixed up with those he collected from the Andamans, causing much confusion in their geographical location. Most of the species collected by him were collected again by later botanists and their occurrence in the Andaman Islands was confirmed. However, a few specimens are yet to be obtained, and their existence among the islands of Andamans is unconfirmed.

The tropical rain forests of the Andaman and Nicobar Islands are known to possess many rare and potentially useful wild relatives of economically important plant species such as wild rice (*Oryza indandamanica* Ellis), wild tea (*Camellia kissi* Wall.) and wild nutmeg (*Myristica andamanica* Hook. f.). Wild occurrence of popular cultivars like coconut palm (*Cocos nucifera* L.) and betel vine (*Piper betle* L.) among the islands of the Andamans are indicators on their point of origin. Many of them are promising in the field of modern agriculture and traditional systems of medicine. *Piper ribesioides* Wall., a species allied to *Piper cubeba* L. f. collected by Dr. Helfer in 1834 was deposited at Kew with the locality mentioned as Tennassarium/Andamans (sic). The occurrence of this species in Andaman Islands was doubtful till its recent discovery from the Mount Harriet hill ranges and collections made by one of the authors (S.P. Mathew 20558 PBL & K). During the present floristic survey, this species was found growing along the edges of the Semi-evergreen Forests of Mount Harriet, the highest peak in South Andamans near the Wright Myo village.

Piper ribesioides Wall., Pl. As. Rar. 1:79. t. 9. 1830; DC. in Jour. Asiat. Soc. Bengal 75: 322. 1849 & Prodr. 16 (1): 342. 1869: Hook. f. , Fl. Brit. India 5: 81. 1886; Ridly, Fl. Mal. Penin. 3: 34. 1927. *P. sumatranum* C. DC., Prodr. 16 (1): 343. 1869; Hook. f., 1. *c.* 81.

Dioecious woody lianas; main stem *c.* 6 cm across, bark greyish, lenticellate with nodal annular rings, nodes swollen. Leaves 10-17 x

6-9 cm, ovate to oblong-ovate or rarely lanceolate, deeply cordate at base, acute or shortly acuminate at apex, coriacious, 8 to 9 nerved; petiole *c.* 6 cm, more or less robust. Female spikes *c.* 6 cm long. Drupes up to 6 mm across, globose on stout peduncles up to 2.2 cm long, orange turning red in colour, very pungent; pedicels up to 1 cm long.

Status: Very rare, most probably endangered.

Distribution: Malay Peninsula and Andaman Islands.

Habitat: Semi-evergreen Forest at an altitude of 50-60 m in humus-rich soil. Usually associated with tall forest trees like *Terminalia* spp.

Fl. & Fr.: October-March.

Conservation Status: No intensive measures were adopted for *in situ* conservation. A few plants have been introduced in the field gene bank established at the Tropical Botanic Garden and Research Institute under an *ex situ* conservation programme of the Andaman species undertaken by the Institute.

Specimen examined: South Andamans, Wright Myo, 22.v.1990, S.P. Mathew 20558 (PBL & K).

Though the genus *Piper* L. is well represented in the tropical and subtropical regions, it is rather poorly represented in the Andaman and Nicobar Islands. Based on the literature survey and herbarium specimens at PBL & CAL, there are only six species known to occur among the Islands. There are a few vegetative specimens from the Nicobar Islands deposited at PBL & CAL identified as *Piper clypeatum* Wall. However, the occurrence of this taxon is uncertain, due to the non-availability of their flowering and fruiting specimens. Hooker included *Piper ribesioides* Wall. under the taxonomic section *cubeba*. The dioecious nature, presence of solitary spikes, peltate female bracts and pedicellate fruits made Hooker suggest that *Piper ribesioides* Wall. may be another form or a genetic variant of *Piper cubeba* L. f. This species also resembles *Piper pedicellosum* Wall. ex DC, another endangered species recorded from the Andaman Islands, of which there are a few old specimens at CAL. Hooker suggested that *Piper ribesioides* Wall. can be easily distinguished from the former by the larger size of leaves, petioles and pedicels. However, a thorough and detailed taxonomic study is required to make a conclusion, which is not possible due to the lack of adequate herbarium specimens. The specimen collected from Mount Harriet by one of the authors (S. P. Mathew 20558) was compared with the specimens at Kew and was found similar to *Piper sumatranum* C. DC., but this has been merged under *Piper ribesioides* Wall. The ripened fruits of *Piper ribesioides* Wall. are known to be used by the local people for treatment of mouth ulcer.

Acknowledgements

We thank Dr. N. P. Singh, former Liaison Officer (Botanical Survey of India), Royal Botanic Gardens, Kew, England for confirming the identity of the specimens. One of us (SPM) thanks the Director, Tropical Botanic Garden and Research Institute for encouragement. Financial assistance provided to Prof. Susan Abraham by the Department of Science and Technology, Govt. of Kerala is gratefully acknowledged.

April 22, 2000

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34. NEW RECORD OF *NERVILIA ARAGOANA* IN RAJASTHAN

During a field survey on August 24,1993, in Sitamata Sanctuary in Chittorgarh district of Rajasthan, I came across many plants of *Nervilia aragoana* between *Bhagya Baori* and Sitamata Temple under huge crowns of *Madhuca indica*, *Mangifera indica*, and *Buchnania lanzan*. *Nervilia aragoana* is a terrestrial orchid with a single, simple, orbicular leaf, raised on a long stalk. Its leaf has a cordate base, ribbed lamina and wavy margins. This plant grows in fairly good numbers in the plain areas along the nullahs.

No earlier literature on the flora of Rajasthan (Mehta 1979; Sharma and Tiagi 1979; Shetty and Pandey 1983; Shetty and Singh 1987, 1991, 1993; Singh 1983) has recorded *Nervilia aragoana* from the State. Thus, the present record of the species is the first from Sitamata Sanctuary as well as Rajasthan State.

I thank Mr. U.M. Sahai, Conservator of Forests, for facilities.

June 14, 1999

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35. REDISCOVERY OF *HEMIORCHIS PANTLINGI* (ZINGIBERACEAE) FROM SIKKIM HIMALAYA

(*With one text-figure*)

During a recent floristic survey of South Sikkim, I came across an interesting species of *Hemiorchis* Kunz. On examination, the plant was identified as *Hemiorchis pantlingi* King. The plant was rediscovered after a gap of about one hundred years. The voucher specimens are deposited in the herbarium of the Botanical Survey of India, Gangtok, Sikkim.

The description of the species, along with a diagram (Fig. 1), is given below:

Hemiorchis pantlingi King: *In*: Mitra J. N., Flowering Plants of India, Vol. 1 Monocotyledons: 249-250.1958.

7.5-16 cm tall, erect, succulent, puberulous, perennial herb, conspicuously green, leaves absent. Rhizome stout, much branched, creeping. Stem 4-5 cm long, erect, covered with 3-4, 2-3 cm long, oblong-ovate, creamish-purple, minutely puberulous, stem-clasping, sheathing leaves. Inflorescence 3.5-9 cm long, terete, minutely puberulous; Peduncle 0.5-1.5 cm long; Raceme 3-7.5 cm long, with 2-5 sessile flowers. Floral bracts small, membranous and deciduous. Calyx (3) tubular, 1-1.5 cm long, puberulous outside, free arm shallow, triangular in shape. Corolla 1.5-1.6 cm long, tubular below, limbs divided above into 3 dissimilar lobes; dorsal lobe 1-1.8 x 0.4-0.6 cm, elliptic-oblong, distinctly 3-nerved,

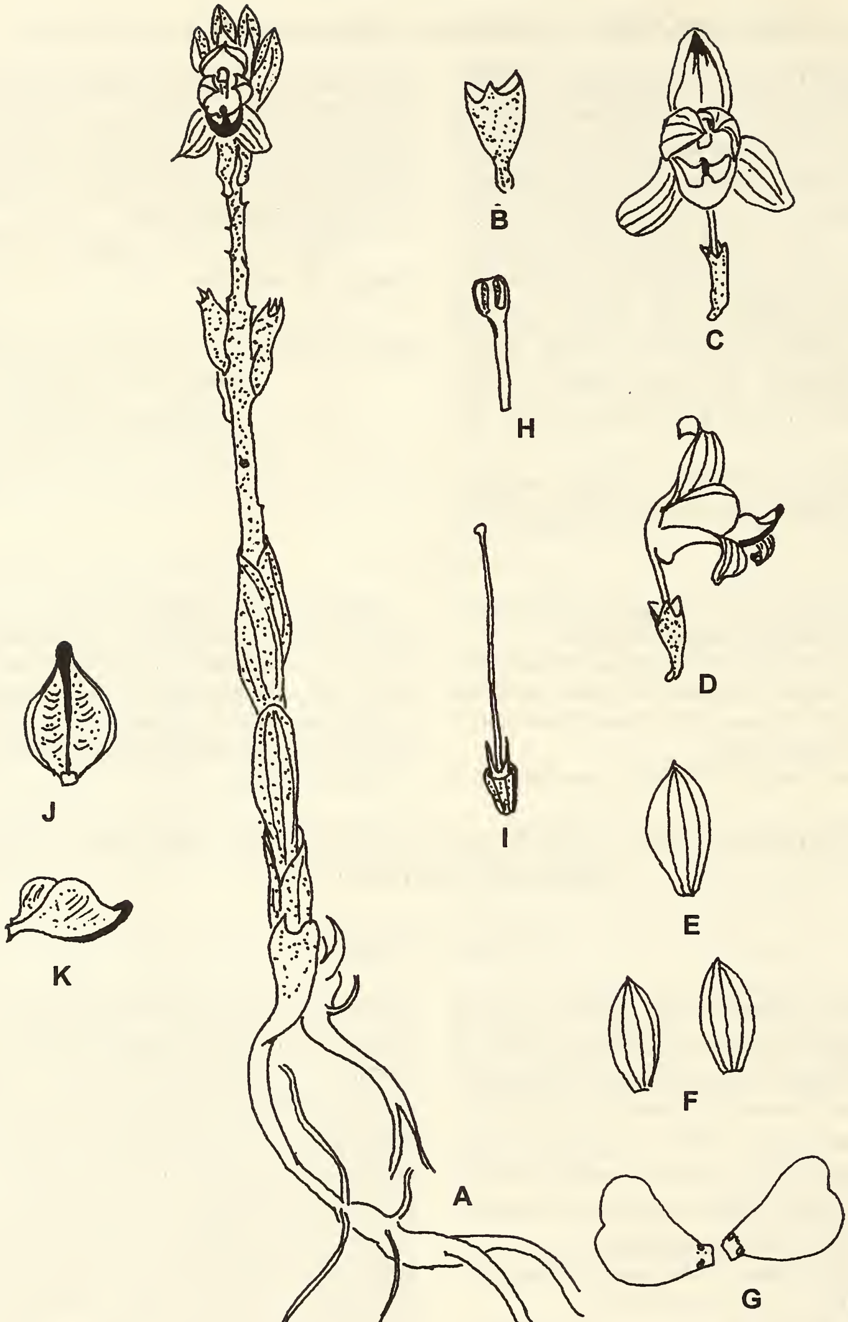

Fig. 1: *Hemiorchis pantlingi* King, A. Whole plant; B. Tubular calyx; C. Single flower; D. Lateral view of a single flower; E. Dorsal petals; F. Lateral petels; G. Lateral petaloid staminodes; H. Stamen; I. Style, stigma, ovary with stylodes; J. Plan view of lip; K. Side view of lip

mucronate tip fleshy, externally puberulous, translucent-white suffused with purple; lateral lobes 0.9-1.1 x 0.3-0.5 cm, elliptic-oblong, distinctly 3-nerved, spreading. Lateral staminodes petaloid 0.8-0.9 x 0.6-0.65 cm, obovate, obtuse, slightly and unequally bilobed, basal end with 2 reddish-purple secreting glands, base united to form a short spur. Lip *c.* 1.2 x 1.2 cm in diameter. When flattened, cupular, fleshy, orange-yellow with reddish-purple dots and streaks, the median vein thickened from base, and forms a blunt projection in front, deep orange in colour. Stamen 6-7 mm long, curved, anthers at right angles to it; Anther cell *c.* 4 x 2 cm long, oblong, contiguous, connective narrow, not produced. Style *c.* 2.1 cm long, slender, translucent-white, glabrous, passing through the furrow of anther or connective of anther. Stigma small, sub-globose. Ovary *c.* 3.5 mm long, ribbed, minutely hairy, with 2 stylodes *c.* 3.8 mm long crowning the ovary, 1-celled with many ovules, with parietal placentation.

Flowering: April
Altitudinal Zones: 300-500 m.
Distributional Status: Rare
Remarks: It grows on the burnt Sal forest floor.

ACKNOWLEDGEMENTS

I am grateful to Mr. T.R. Sharma, Principal Chief Conservator of Forests - cum - Secretary, Forest Department, Government of Sikkim, for permission to carry out the field survey. I especially thank Dr. P.M. Singh, Scientist SD, Botanical Survey of India, Gangtok, for valuable suggestions.

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36. *ARISAEMA ECHINATUM* (WALL.) SCHOTT — AN ADDITION TO THE ARACEAE OF PENINSULAR INDIA

(*With one text-figure*)

While revising the genus *Arisaema* Mart for a study on the Araceae of India, it was found that the material of an *Arisaema* species at Madras Herbarium (MH), collected in the Silent Valley on the Western Ghats, Kerala, had been wrongly determined as *A. erubescens* (Wall.) Schott. Critical examination revealed that it is *A. echinatum* (Wall.) Schott. The identity was later confirmed with the help of the protologue and type. *Arisaema echinatum* is known to occur in Manipur, Meghalaya and Sikkim in India, and also in Bhutan, China and Nepal. It is recorded here from Kerala for peninsular India. A detailed description is provided.

Arisaema echinatum (Wall.) Schott in Schott & Endl., Melet. Bot. 1: 17. 1832; Hook. f., Fl. Brit. India 6: 506. 1893; Engl., Pflanzenr. (IV. 23 F) 73: 181. 1920; D. Chatterjee in Bull. Bot. Soc. Bengal 8: 124. 1955; Hara, Fl. E. Himal. 2: 152, t. 20, f. c-d, 351, f. 55m. 1971; Pradhan, Himal. Cobra-lilies: 90. 1990. *Arum echinatum* Wall., Pl. Asiat. Rar. 2: 30, t. 136. 1831; Wall., Numer. List No.: 8916. 1848; Engl. in DC., Monogr. Phan. 2: 555. 1879. - Type: Nepal, Sheopore, 1821, Wall., Numer. List No. 8916 (CAL, K, MH microfiche!).

Dioecious, rarely monoecious, cormous herb; corm 2-5 cm across, depressed-subglobose. Cataphylls 1-2, 2.5-22 cm long, obtuse, membranous. Leaf solitary; petiole 12.5-46 cm long, cylindric, pale green, streaked with reddish-brown, glaucous; leaflets 6-11, radiate, subsessile, 4.5-30 x 0.7-4 cm, oblanceolate to oblong-lanceolate, attenuate or subacute at the base,

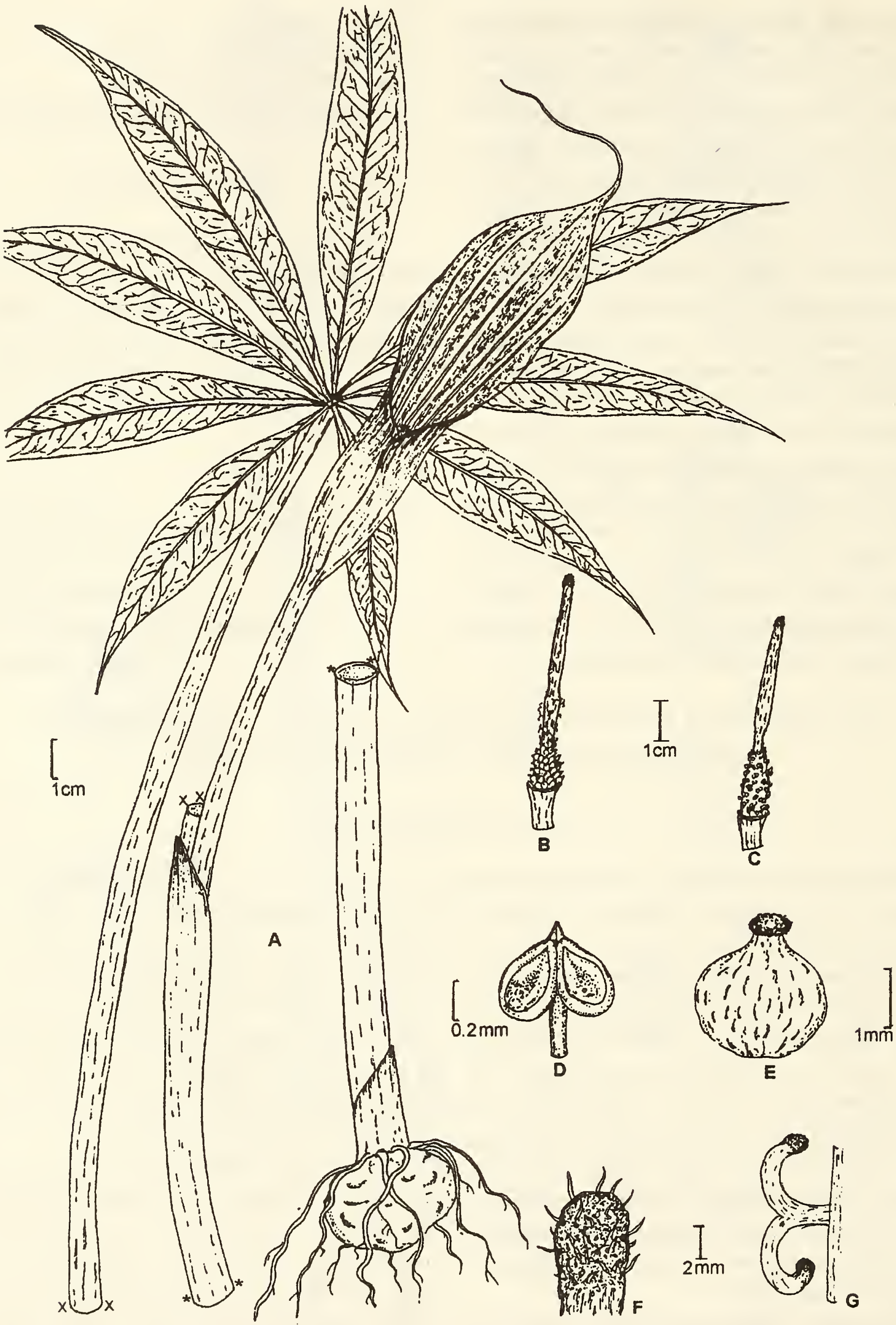

Fig. 1: *Arisaema echinatum* (Wall.) Schott: A. Habit; B. Bisexual spadix; C. Staminate spadix; D. Staminate flower; E. Pistillate flower; F. Apex of spadix-appendix; G. Sterile flower

undulate along the margins, caudate-acuminate at the apex, deep green above, pale green with streaks and glaucous beneath; midnerve broad at the base, narrowing towards the tip; lateral nerves slender, 10-14 on each side, obliquely ascending from midnerve, continuous to form intra-marginal nerves. Peduncle solitary, 7-35 cm long, green, streaked with reddish-brown, enclosed by the petiole and then exserted. Spathe 9.5-27 cm long, green, striped with white, brown or purple inside, dull white outside, glabrous; tube 3-6 x 1.5-2 cm, cylindric, convolute, green-and-white striped outside, dark purple striped inside, spreading at the mouth; limb 3-7 x 2.5-5 cm, ovate-lanceolate, vaulted, abruptly tapering into a long slender pendulous 5-15 cm long tail. Spadix included, cylindric, erect, hardly exserted beyond the mouth of the tube. Pistillate spadix 4-7.5 cm long; pistillate flower-portion 0.7-1.5 cm long, dense, with a few sterile flowers above (or none) along with a few staminate flowers; pistillate flowers many, 1.5-2 x 1.7-1.8 mm; ovary 1.5-1.7 x 1.5-1.8 mm, subglobose, green, streaked; ovules 2-3, basal; style minute; stigma discoid, white, viscid. Sterile flower-portion *c.* 1 cm long; sterile flowers 1-3.5 mm long, subulate, bifurcate, purple at the apex. Staminate spadix 4-6.5 cm long; staminate flower-portion 1.5-2 cm long; staminate flowers many, sparse; filament 0.1-0.5 mm long; anthers 1-5, 2-lobed, purplish brown, dehiscing by a pore; lobes 0.4-0.7 x 0.5-0.9 mm, globose or depressed-subglobose; connective beaked. Appendix 2.5-4.5 x 0.5-0.9 cm, cylindric or slightly compressed, light green, streaked with purple, swollen at the base, contracted in the middle, rugose or echinate with white bristle, 0.07-0.2 cm long, round margins crenate at the apex. Appendix of staminate spadix distinctly stipitate; stipe *c.* 0.5 cm long. Berries *c.* 0.6 cm long.

Fl. & Fr.: Feb.-July.

Note: Easily distinguished by its densely echinate spadix-appendix apex. Commonly called the spiny cobra-lily (Pradhan *l.c.*). Berries of *Arisaema* spp. are bird-dispersed (Ridley 1930). This species may have been dispersed by birds internally.

Specimen examined: Kerala: Palakkad district, Silent Valley R.F., 900 m, 22.iv.1980, *V.J. Nair* 67259 (CAL, MH). Manipur: Mao, 6,500 ft (1975.25 m), 11.ii.1954, *S.C. Sinha* 1873 (CAL). Meghalaya: Khasia hills, Dumpep, 30.v.1911, *H. Burkill & S.C. Banerjee* 34249 (CAL). Sikkim: North district, Tallam Samolong, 25.vii.1986, *D.C.S. Raju & S. Singh* 6124 (SHC).

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REFERENCE

RIDLEY, H.N. (1930): The dispersal of plants throughout the World. L. Reeve & Co. Ltd, Ashford, Kent. Pp. 396.

37. TWO NEW ADDITIONS TO THE SEDGES, FAMILY CYPERACEAE, OF ANDHRA PRADESH

(*With one text-figure*)

During an exploration on aquatic and wetland angiosperm diversity in Andhra Pradesh, the authors encountered two interesting taxa which, on critical examination, were identified

Mariscus sumatrensis (Retz.) Raynal is akin to *M. paniceus* (Rottb.) Vahl, but it can be distinguished by the following characters:

Mariscus paniceus (Rottb.) Vahl	***Mariscus sumatrensis*** (Retz.) Raynal
Plants not stoloniferous.	Plants stoloniferous but subrigid.
Leafy bracts 3-5.	Leafy bracts 3-10.
Spikes subsessile or nearly so, rays when developed up to 4 cm long.	Spikes umbellate with elongated rays, rays 3-15, the longer ones up to 8 cm long.
Spikes 8-15 x 4-6 mm, densely bearing *c.* 150 spikelets.	Spikes 2-40 x 6-10 mm, densely bearing *c.* 40 spikelets.
Glumes ovate-lanceolate, 2.5-3 x 1.4-1.7 mm, obscurely 2-nerved on each side of the keel.	Glumes lanceolate-oblong to ovate-oblong 3-3.5 x 1 mm, faintly multi-nerved.
Stamens 2, rarely 3.	Stamens 3.
Achenes elliptic-long, 1.8-2.2 x 0.6-0.8 mm.	Achenes linear-oblong, 1.8-2.2 x 0.5 mm.

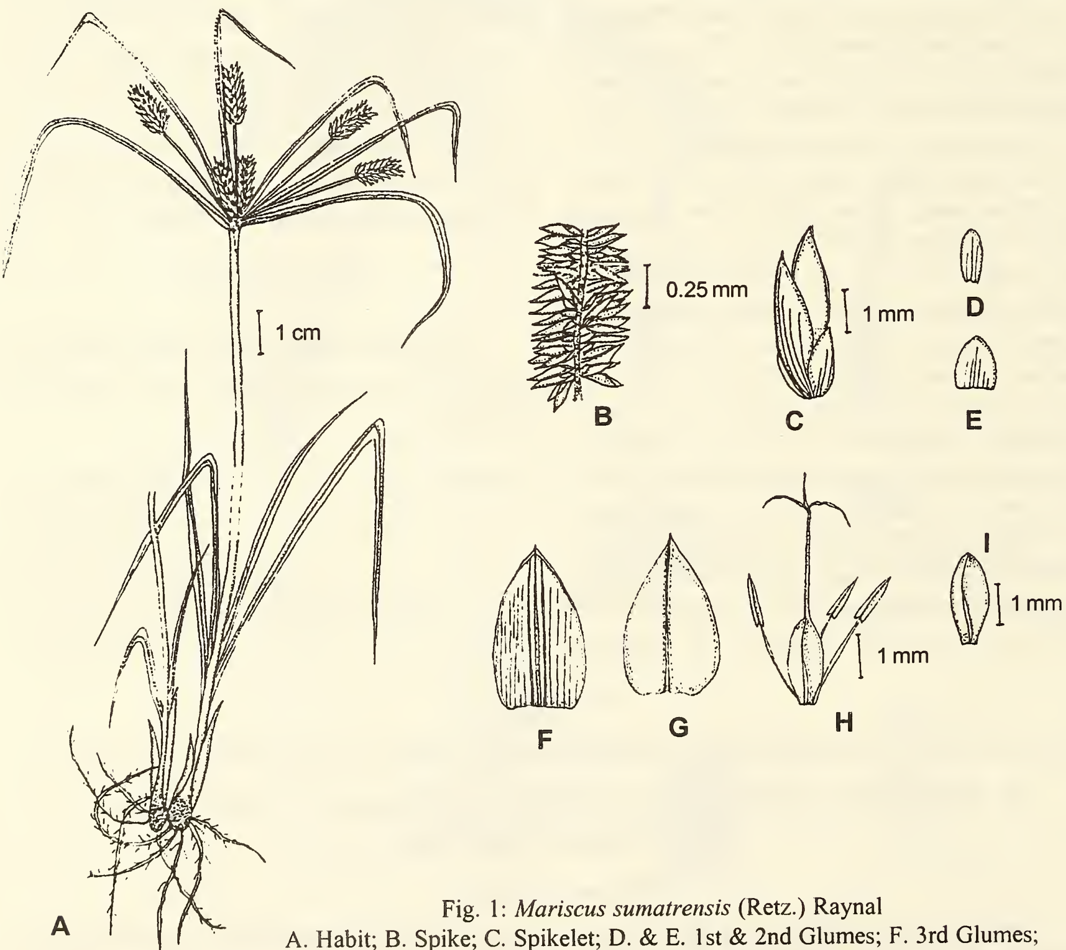

Fig. 1: *Mariscus sumatrensis* (Retz.) Raynal
A. Habit; B. Spike; C. Spikelet; D. & E. 1st & 2nd Glumes; F. 3rd Glumes; G. 4th Glume; H. Pistil & Stamens; I. Nut

as *Mariscus sumatrensis* and *Kyllinga hyalina.* These two taxa have been reported from Maharashtra, Karnataka and Tamil Nadu states by earlier workers. The present report from Andhra Pradesh is, therefore, a range extension.

Intensive ecofloristic surveys were conducted in the ponds, ditches, canals, streams and waterlogged areas in the state, to collect specimens. For taxonomic study, herbarium specimens were prepared using standard methods. Collections were made to understand the influence of climatic factors on certain key characters of the taxa. The specimens were deposited in Sri Krishnadevaraya University Herbarium (SKU), Anantapur.

Mariscus sumatrensis (Retz.) Raynal

Mariscus sumatrensis (Retz.) Raynal, Adansonia 15:110. 1975; T. Koyama, Gard. Bull. Singapore 30:154. 1977. *Kyllinga sumatrensis* Retz., Obs. Bot. 4:13. 1786. type sumatra wennerberg. *Mariscus sieberianus* Nees (Linnaea 9:286. 1835, *nom. nud.*) ex. Clarke in Hook. f , Fl. Brit. India. 6:122. 1893. Fig. 1.

Annual herbs. Culms up to 80 cm tall. Leaves shorter than culms, herbaceous; bracts 3-10. Inflorescence open, simple, rays 3-15. Spikes cylindrical, spikelets linear to linear-lanceolate. Glumes lanceolate-oblong to ovate oblong. Nuts linear-oblong, straw coloured.

Remarks: Rare in marshy areas along the streams.

Fl. & Fr.: August-November.

Distribution: EXTRALIMITAL: Tropical Old World, Introduced in the West Indies, Bangladesh, Sri Lanka, Nepal. INDIA: Andhra Pradesh (Cuddapah district, restricted to Lankamala waterfalls), Assam, Himachal Pradesh, Karnataka, Maharashtra, Sikkim.

Specimens examined: Near Lankamala waterfalls, (CDP), MHR & KI 14904.

Kyllinga hyalina (Vahl) T. Koyama

Kyllinga hyalina (Vahl) T. Koyama, J. Jap. Bot. 51 (10): 313. 1976. *Cyperus hyalinus* Vahl Enum. Pl. 2:239. 1806. *Pycreus pumilus* Clarke in Hook. f., Fl. Brit. India. 6:591. 1893; Fischer 1625 (1130).

Annual herbs. Culms 6-20 cm tall. Leaves shorter than, to slightly overtopping, the culms, thinly herbaceous; bracts 3-6. Inflorescence open and lax, umbelliform with elongated rays, rays 2-6. Spikelets ovate to elliptic. Glumes ovate. Nuts elliptic to broadly elliptic, brown.

Remarks: Sporadically occurring in open forests, especially during rainy season.

Fl. & Fr.: August-November.

Distribution: EXTRALIMITAL: Tropical East Africa, Massacres Is., Indochina, Malesia and Northern Australia.

INDIA: Andhra Pradesh (Cuddapah), Karnataka, Maharashtra, Tamil Nadu.

Specimens examined: Lankamalleswaram east (CDP), SRS & KI 13152.

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38. FOOD VALUE OF SOME EDIBLE FERNS FROM DHARAN, SOUTHEASTERN NEPAL

Within the next three decades, the world will have to double its food production to meet the demand of its increasing population (Myers 1999) and meet the health requirements of

human beings. This is a real challenge. Recent technological advances (Leisinger 1999) and exploitation of unknown or neglected food resources from nature may solve this problem. Nature has endowed us with abundant plant resources. In comparison to the plethora of flora at our disposal, the numbers that have been exploited directly to fulfil human requirements is comparatively small. Ferns and their allies are but a few of them. Some ferns have always been used for culinary purposes, the demand being fulfilled from wild sources. A generic term used in Nepal for all the edible ferns is '*niuro*' or '*niguro*' (Gurung 1984).

Ferns and their allies are among the green vegetables available in the vicinity of Dharan, mainly in the monsoon. Their most common use is as green vegetables. Tender varieties in particular are pickled and sometimes fermented for "*gundruk*", a preparation leafy vegetable indigenous to Nepal (Karki 1986). Less often, edible fern is sun dried and preserved. In some parts of the country, succulent parts of the plant are simply crushed or squashed and eaten, probably to quench summer thirst.

Vegetables are used for organoleptic reasons. That they also contribute significantly towards a balanced nutrition through synergistic interactions among food components, unfortunately, very often goes unnoticed. Although much work has not been done on edible ferns, they could be as valuable as any conventional vegetable (Anon. 1982). The present work attempts to estimate the nutrient contents of some edible ferns growing naturally in and around Dharan, Nepal.

'*Niguros*' are generally available from June to September. All the samples were collected when the plants were tender, from forest areas in and around Dharan. Edibility of the ferns was confirmed from local collectors and vegetable markets of Dharan, where they are often displayed for sale. Identity of plants was confirmed from the National Herbarium and Plant Laboratory, Godavari, Kathmandu, Nepal. The freshly collected samples (about 1 kg each) were carefully packed in polythene bags and sent to the laboratory for chemical analysis.

The plants were prepared and parts unsuitable for culinary purposes were removed, to obtain data as relevant as possible to kitchen protocol. Soil and dirt were meticulously removed. Representative samples were taken for determining moisture, while the remaining were finely shredded and dried in a hot air oven at 110 °C (Rangana 1986). Dried samples were powdered in a mortar, dried once again at 110 °C, packed hot in clean, screwtop glass containers, and reserved in a desiccator. All subsequent analyses were carried out using the reserved powders, which were thoroughly dried using IR radiation before weighing them for analyses.

TABLE 1

PROXIMATE COMPOSITION OF VARIOUS FERNS AND FERN ALLIES FROM DHARAN, NEPAL (PER 100 G EDIBLE PORTION)

Item	Moisture (g)	Carbohydrate (g)	Crude protein (g)	Crude fat (g)	Total ash (g)
Diplazium esculentum Swartz	90.10	4.9	3.4	0.2	1.4
D. maximum (D.Don.) C. Chr.	91.36	4.452	3.01	0.108	1.07
Ophioglossum vulgatum Linn.	92.21	3.356	2.47	1.00	0.964
Sterochlaena palustris (Burm.) Bedd.	91.17	4.982	2.99	0.07	0.778
Tectaria macrodonta (Fee) C. Chr.	91.48	4.186	2.90	0.295	1.139

TABLE 2
ASH COMPONENTS OF VARIOUS FERNS AND FERN ALLIES FROM DHARAN, NEPAL
(PER 100 G EDIBLE PORTION)

Item	Ash Acid-insoluble (g)	Ash Acid-soluble (g)	Calcium (mg)	Iron (mg)
Diplazium esculentum Swartz	-	-	-	2.77
D. maximum (D. Don.) C. Chr.	0.0649	1.005	17.24	0.84
Ophioglossum vulgatum Linn.	0.0647	0.899	36.31	7.01
Sterochlaena palustris (Burm.) Bedd.	0.0857	0.702	9.59	0.92
Tectaria macrodonta (Fee) C. Chr.	0.0735	1.066	16.63	4.95

Particulars of the parameters and the assessment methods used were as under:

Parameter	**Method**
Crude Protein	Rangana 1986; Kjeldahl method
Crude fat	Pearson 1976; Solvent extraction
Ash (Total and acid-insoluble)	Rangana 1986
Moisture	Rangana, 1986; IR method
Carbohydrate	Horwitz 1980; By difference
Iron	Rangana 1986; Colorimetric method
Calcium	Horwitz 1980; AOAC method, titrimetric

Proximate analysis of the collected samples showed favourable comparison with other conventional vegetables. The results of proximate analysis and various ash components of the samples are presented in Tables 1 and 2, whereas Table 3 is a compilation from earlier publications. Mudambi and Rajagopal (1990) had analysed a number of leafy vegetables, the composition of which is given in Table 3.

Comparison of Tables 1, 2 and 3 shows that the food values of the above five species of pteridophytes average those of conventional vegetables. In general, *Ophioglossum vulgatum* and *Tectaria macrodonta* are the prized ones. They excel other varieties not only in terms of quality, but also in organoleptic values. Besides, they have curiosity value and so they sell more. Moreover, the amino acid profile of ferns is reported to be similar to spermatophytes in terms of type and abundance, the sequence in decreasing order being arginine, lysine, tyrosine, methionine, tryptophan and cysteine (Meyer, 1960).

However, nutritional value notwithstanding, these wild vegetables cannot be expected to contribute much to our dietary

TABLE 3
PROXIMATE COMPOSITION OF '*NIGURO*' AND CONVENTIONAL LEAFY VEGETABLES
(PER 100 G EDIBLE PORTION)

	Protein (g)	Fat (g)	Carbohy drate (g)	Moisture (g)	Crude Fibre (g)	Minerals (g)	Calcium (mg)	Vit.C (mg)
Green leafy vegetables*	1.8-4.4	0.1-1.7	1.4-12.5	75.9-95.2	-	0.6-2.7	-	-
*Niguro***	4.4	0.2	4.2	88	1.8	1.3	30	4.8

Sources; * Mudambi and Rajagopal (1990)

** Anonymous (1986)

requirements unless mass cultivated, and no such efforts seem to have ever been made. What comes to the market is directly from the wild, and this trend is likely to continue, unless further research to cultivate and exploit them is conducted.

The present work is still fragmentary. The data obtained by chemical analysis is not necessarily relevant to intricate biological systems of nutrition and absorption. But emphasis must be placed on bio-availability. For instance, protein must be further assayed to determine the digestibility and indispensable amino acid profile. Minerals are available only in the absence of interfering entities such as oxalates and phylates. Vitamin profile, crude fibre content and toxic principle(s), if any, are other important aspects that must be thoroughly researched before popularising wild plants for edible purposes.

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ERRATA

Vol. 98(2), p. 288. The 2nd author Yogesh Srivastawa was inadvertently printed as Yogesh Sharma. The error is regretted.

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